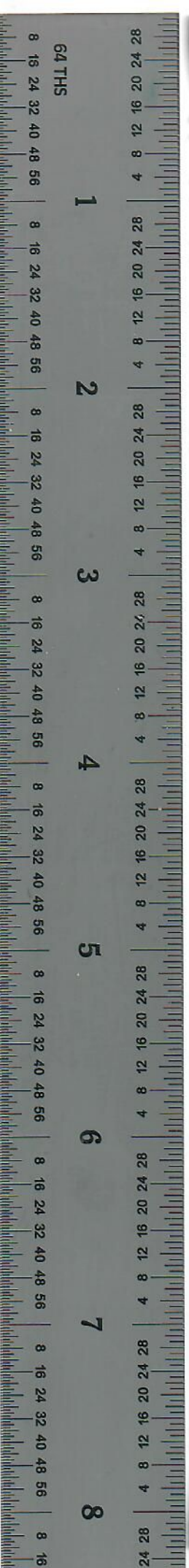
EMD

Engineer's Operating Manual

MODEL E8

GENERAL MOTORS LOCOMOTIVES

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION • LA GRANGE, ILLINOIS, U. S. A.



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DIESEL LOCOMOTIVE OPERATING MANUAL

NO. 2311

FOR

MODEL E8

1st Edition

November, 1949

This manual covers operation of the E8 locomotives. Coverage of the Dynamic Brake is included. The manual is written to be complete with or without this coverage so that on locomotives not equipped with Dynamic Brake reference to this subject may be eliminated without detracting from coverage of the locomotive.

Price $3.50

ELECTRO-MOTIVE DIVISION
General Motors Corporation
LA GRANGE, ILLINOIS, U. S. A.

PRINTED IN U. S. A.

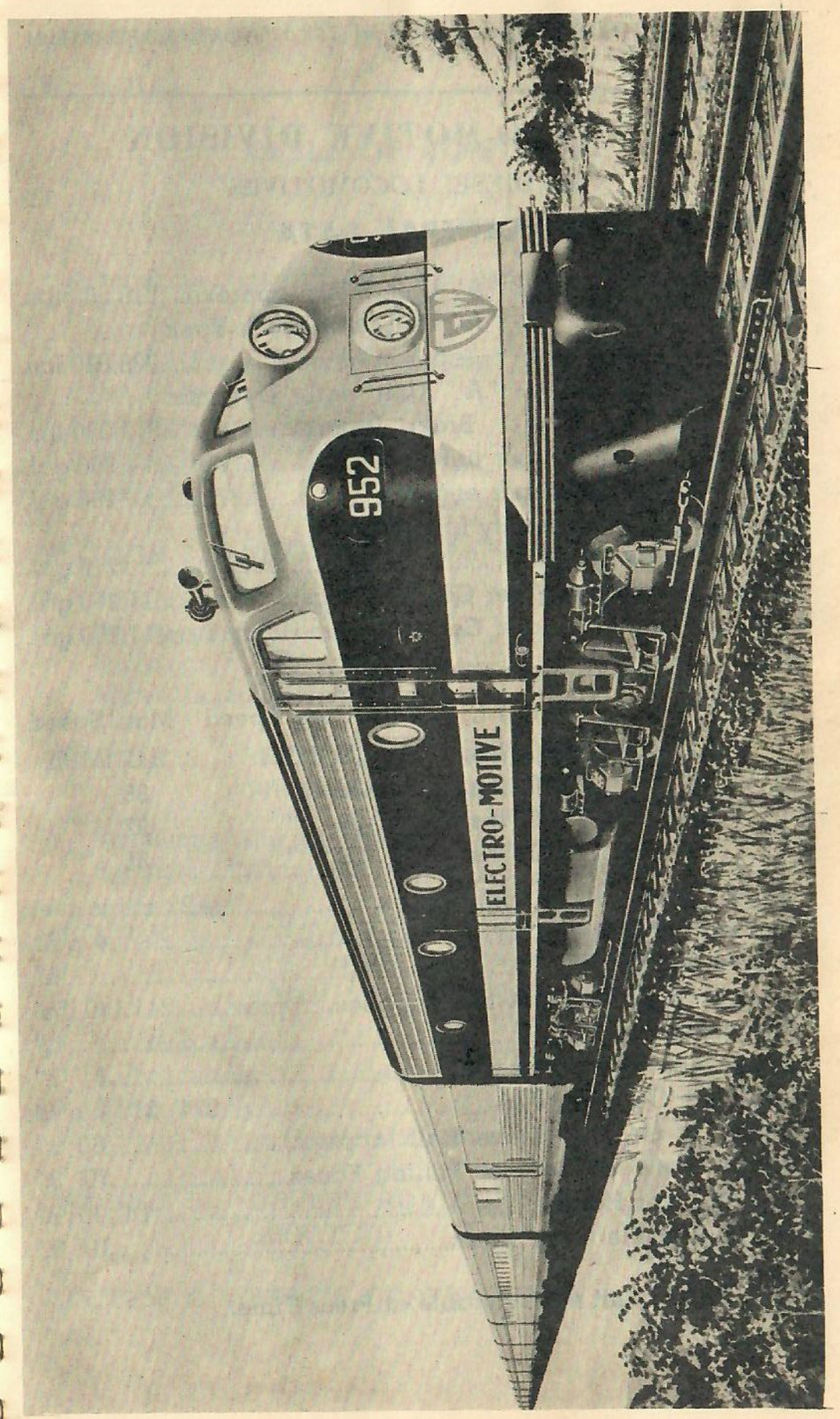
INTRODUCTION

This manual has been produced to assist the engineman in the operation of the Model E8 locomotive. It covers basic (standard) equipment, as well as the most commonly used "extras."

The first three sections of this manual are devoted to a description of the locomotives, normal operation over the road, and special conditions and problems during operation. Section 4 consists of a general description of the cooling, lubricating oil, fuel oil and engineroom ventilating systems and other necessary information for operation of the locomotive. Section 5 covers the steam generator. Section 6 consists of a reprint of the TS-3 "On-the-Road Trouble Shooting" booklet.

The principal articles of each section are numbered consecutively for ready reference, as is each page of the section. Articles and pages are numbered in the 100 series type of numbering, a page in the 300's is in Section 3 as is any article numbered in the 300's.

A "General Arrangement, Drains and Fillers" chart of "A" units follows Section 5.



NOTES

Instructions on Page 208. must be observed and complyed with when EPB is used in Freight service on a long haul such as Darlington Wooster Ohio, and from Conway to Summit.

Loss of control air Page 117. Can be adjusted to Main Res Pressure. if Necessary to increase Pressure. by adjustment of reducing Valve. behind Eng steps on right side

SECTION 1

GENERAL DESCRIPTION

A description and general location of equipment on the basic E8 locomotive is given in this section.

A locomotive consists of one or more units rated at 2250 horsepower each. The units which are equipped with an operating cab are designated "A" units, those without cabs as "B" or booster units. Different combinations of units are used, depending on the horsepower and operating requirements.

100 **Diesel Engines** Each unit has two 12-cylinder 2-cycle Model 567B Diesel engines which drive the main generators and auxiliaries described later.

101 **Main Generator And Alternator** main generator and alternator assembly are directly connected to the Diesel engine crankshaft through a flexible coupling. Two electrically separate sections are mounted on the same shaft and designated as Model D15-D16. The D15 portion produces direct current at a nominal voltage of 600 volts for operation of the traction motors. The D16 section, built into the engine end of the main generator frame is a three phase, 40 KW alternating current generator which furnishes power to drive the engine water cooling fans, and the ventilating fans.

102 **Traction Motors** Four traction motors are used in each unit, mounted one on each power axle. Each motor is geared to the axle which it drives by a motor pinion gear meshing with an axle gear. The gear ratio between the two gears is expressed as a double number such as 52/25. In this case, the axle gear has 52 teeth while the pinion has 25 teeth.

ELECTRO-MOTIVE DIVISION

E8 DIESEL LOCOMOTIVES

GENERAL DATA

Weight (fully loaded) "A" Unit, Basic (approx.)....318,560 lbs.
"A" Unit with Hatch Tank (approx.) .....326,810 lbs.
"A" Unit with Dynamic Brake (approx.).....319,380 lbs.
Fuel Oil Capacity (per unit).....1,200 gal.
Lube Oil Capacity (per engine)..... 165 gal.
Cooling Water Capacity (per engine)
"G" Valve Level ..... 218 gal.
Steam Generator Water Capacity, Basic.....1,350 gal.
Steam Generator Water Capacity with Hatch Tank..1,950 gal.

Gear Ratios and Speeds

Gear Ratio	Cont. T.E.	Min. Cont. Speed	Max. Speed
52/25	19,600 lbs.	36 MPH	117 MPH
55/22	23,600 lbs.	30 "	98 "
56/21	25,200 lbs.	28 "	92 "
57/20	26,800 lbs.	26 "	85 "

Sand Capacity (per unit) approx.....22 cubic feet
Number of Drivers (per unit).....4 pair
Wheel Diameter.....36"
Weight on Drivers (one-half supplies, approx.).....211,140 lbs.
Truck Centers .....43'
Truck Rigid Wheelbase.....14' 1"
Minimum Curve Radius.....274' 21° curve
Center of Gravity above Rail (approx.).....60½"
Length: Between Coupler Pulling Faces.....70' 3"
Height: Over Horns.....14' 10½"
Width: Outside Grab Irons.....10' 8"

Data on "B" unit not available at Press Time.

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Three steps of traction motor electrical connections (called transition) are used during acceleration: 1) series, 2) parallel, and 3) parallel-shunt.

This transition compares roughly to "hooking up" a steam locomotive making it possible to utilize the full horsepower output of the engines and takes place automatically while operating locomotives in automatic transition position. During deceleration, the steps take place in reverse order. Backward transition is automatic from 3 to 2, but to effect backward transition from 2 to 1, the throttle MUST be closed to idle and opened again.

103 **Reversing Locomotive** Reversing the locomotive is accomplished by moving the reverse lever in the control stand to the desired direction. The reverse lever must be moved ONLY when the locomotive is standing still.

104 **Auxiliary Equipment** Auxiliary equipment in the E8 locomotive is driven entirely by direct drive from the Diesel engine or by separate electric motors. No belts are used in the locomotive.

The 10 KW auxiliary generator is directly driven from the Diesel engine. A fan is mounted on each end of the auxiliary generator armature shaft. One fan furnishes cooling air for the main generator and the other fan furnishes cooling air for the traction motors. The auxiliary generator produces direct current at approximately 74 volts to charge the storage batteries and supply the low voltage circuits for lighting, control, generator field excitation, fuel pump operation, etc.

The air compressor is driven through a flexible coupling from the armature shaft of the main generator. It is a two cylinder, two stage water cooled compressor.

Electric driven cooling fans supply the air for the engine cooling water radiators, and ventilating fans (one per engine) supply filtered air to the engineroom.

ENGINEMAN'S CONTROLS

Three levers and the two brake valve handles control the entire operation of the locomotive. These are the throttle, reverse and transition levers which are mounted in the control stand and the independent and automatic brake valve handles.

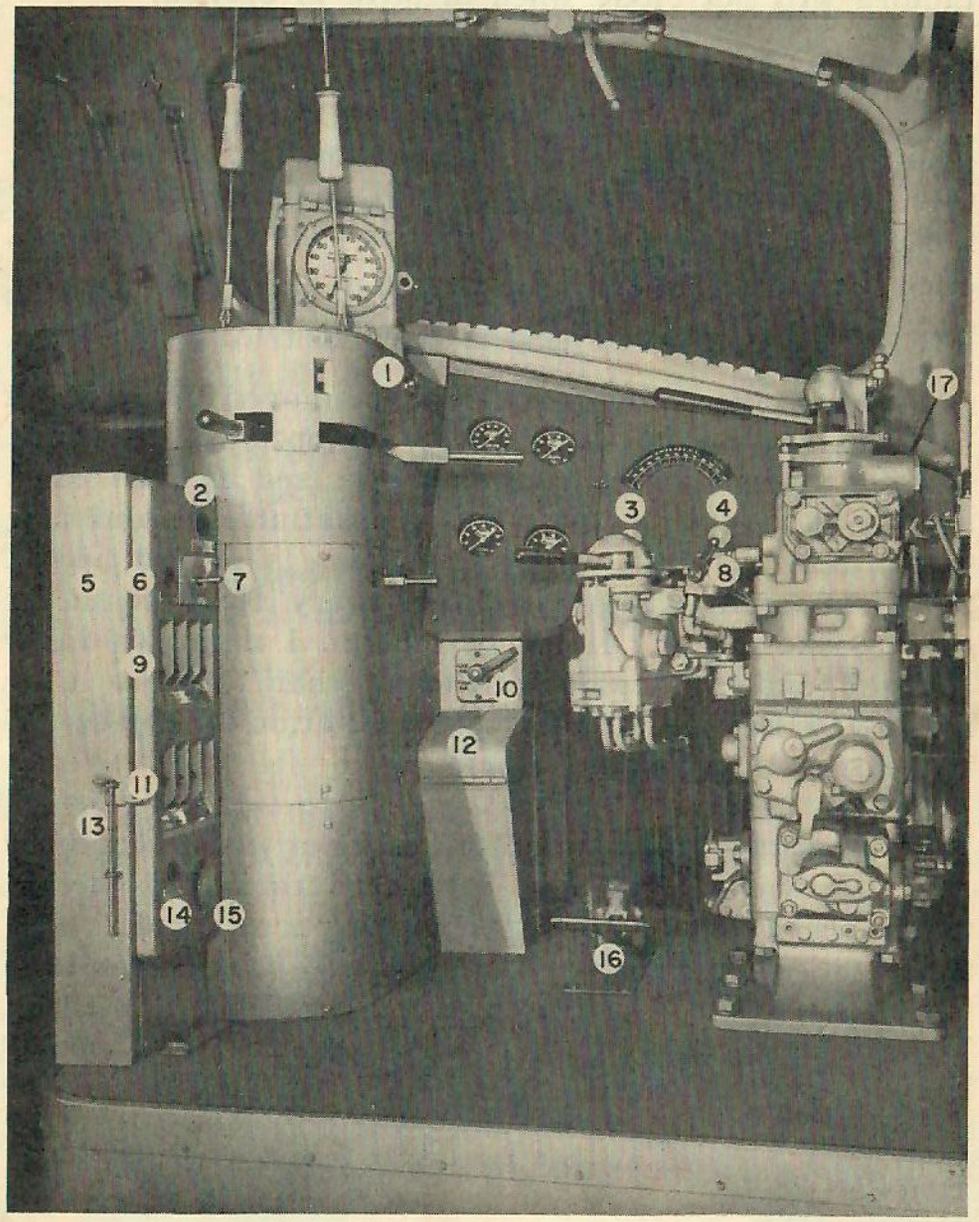
If the locomotive is equipped for dynamic braking, the transition lever has power, off and braking positions.

105 **Throttle Lever** This lever controls the speed of the engines and the train speed in normal operation. The position of the throttle is shown in the illuminated indicator above the lever. The throttle has ten positions, stop, idle and running speeds 1 to 8. Stop can be obtained by depressing the emergency stop button on the end of the throttle lever and pushing the throttle lever one step beyond the idle position. This stops all engines. Idle position is as far forward as the throttle lever can be moved without depressing the emergency stop button. Each running notch on the throttle increases the engine speed 75 RPM from 275 RPM at idle to 800 RPM at full throttle. Mechanical interlocks prevent the throttle from being opened more than one notch at a time to prevent rough train handling. The throttle may be closed completely with one motion in an emergency, but should be closed only one notch at a time in normal operation.

106 **Reverse Lever** The reverse lever can be removed from the control stand in neutral position only. This locks the operating controls in the control

LEGEND OF ENGINEMAN'S CONTROLS

1. Rheostat — controls intensity of throttle indicator lights.
2. Red light shows when Mars headlight (if used) is in red position.
3. Wheel slip light. This light is also used as an overload light when equipped for dynamic braking.
4. PCS open light.
5. Control circuit breaker panel.
6. Attendant's call push button.
7. Headlight bright, dim and off control.
8. Bell ringer valve.
9. Circuit breakers: from left to right, "Gauge Lights," "Number Lights," "Class Lights," "Signal Light,"
10. Damper control, cab ventilation.
11. Circuit breakers: from left to right, "Generator Field," "Fuel Pump," "Control."
12. Hinged cover over "Rotair" valve.
13. Pin for locking control circuit breakers in "Off" position.
14. Manual reset button for Mars headlight (if used).
15. Location of "Unit Selector" switch. Used only on locomotives equipped for dynamic braking.
16. Safety control foot pedal.
17. Behind automatic brake valve, on panel — heater switch, defroster switch, windshield wiper control valve, and rheostat for controlling gauge lights.



Engineman's Controls
Fig. 1-1

stand. With reverse lever in neutral, the power contactors will not close when throttle is opened.

107 **Transition Lever** This lever is on the left side of the control stand, and has "POWER" and "OFF" positions. On locomotives equipped for dynamic braking, this lever also has a "BRAKING" position. The locomotive is started with the lever in "POWER" position.

The transition lever should always be placed in "OFF" position when unit is used in trailing position.

When the transition lever is moved to the first braking position, on locomotives equipped with dynamic brakes, the braking contactors are closed and the camswitch is moved to tow position, partially establishing the braking circuit. When the lever is moved beyond the first braking position the battery field contactor closes, exciting the fields of the No. 1 main generator in each unit in series with each other. As the lever is moved farther to the right excitation is increased, increasing the braking effort.

108 **Dynamic Braking** Some locomotives are equipped for dynamic braking. As the traction motor armatures are geared to the axles, they are turning at all times the train is moving. In dynamic braking position, the motors are used as generators, retarding the train. The current thus generated is dissipated in grids cooled by one motor driven fan, located near the top of the carbody. The grid cooling fan motor, receives its current from that generated by the traction motors.

109 **Mechanical Interlocks On The Controller** The levers on the control stand are interlocked so that:

1. The reverse lever can be operated only with the throttle at "IDLE," and the transition lever in either "POWER" or "OFF" position.

2. The reverse lever can be removed from the control stand only with the throttle at "IDLE," and the transition lever in the "OFF" position.
3. The throttle can be moved to "STOP" with any position of the reverse or transition levers.

ENGINEMAN'S INSTRUMENT PANEL

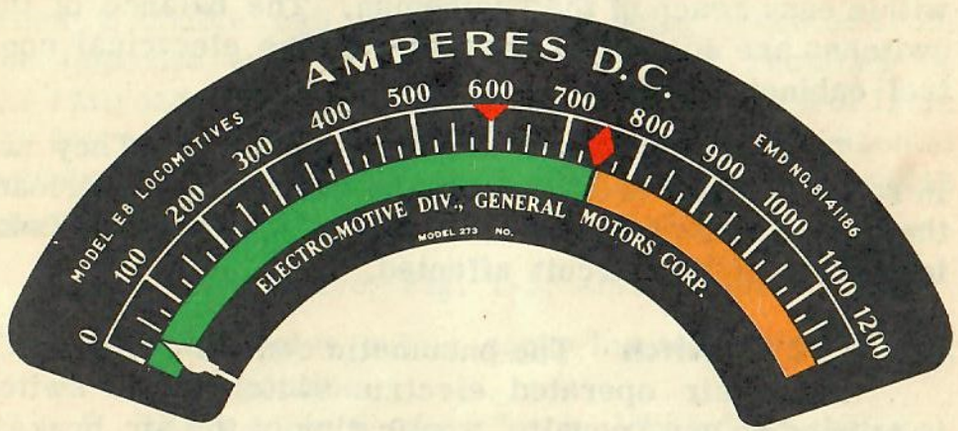
The instrument panel contains gauges and light indicators to guide the engineman in the proper operation of the locomotive.

110 **Air Gauges** These are standard gauges. Each gauge is clearly labeled as to its function.

111 **Load Indicating Meter** This meter is an accurate guide to the load on the locomotive.

The dial of the meter is graduated into amperes starting at 0 at the left and going to 1200 amperes at extreme right of the scale.

A red diamond and a black line at 750 amperes show the maximum continuous current rating. A red



Load Indicating Meter
Fig. 1-2

triangle at 600 amperes shows the maximum permissible current when using dynamic brakes. A white pointer moves across the dial to indicate the amount of traction motor amperes.

112 **Wheel Slip Light** This light indicates that the locomotive wheels are slipping, and the throttle should be reduced one or more notches to stop the slipping.

113 **Dynamic Brake Warning Light** The wheel slip light is also used as a dynamic brake warning light on locomotives equipped with dynamic brake.

As the maximum braking effort is exceeded, the brake warning relay is energized, lighting the wheel slip light to indicate an overloaded condition, at which time the braking effort should be reduced.

SWITCHES

The engineman's control switches most frequently used are placed on a control panel to the left of and within easy reach of the engineman. The balance of the switches are located on the side of the electrical control cabinet, directly behind the fireman.

These switches are not fuse protected. They are in reality circuit breakers. In the event of an overload, the button snaps to the "OFF" position, giving a visual indication of the circuit affected.

114 **"PC" Switch** The pneumatic control switch (PC) is an air operated electric switch. This switch is tripped by any "penalty" application of the air brakes. On most locomotives an emergency application of the brake will also trip the "PC" switch. When this switch is tripped, it automatically reduces the speed of the

engines to idle and shuts off all fuel pumps. If the throttle is in the 5th or 6th notch when the PC switch is tripped, the engines will stop. Some locomotives are equipped with an indicating light which will show when the switch is tripped. To reset the switch the throttle must be returned to idle and the brake "recovered." When this has been accomplished the "PC" switch will reset itself and the indicating light will go out.

AIR BRAKE EQUIPMENT

The 24 RL brake equipment is normally used on the E8 locomotives. The air brake gauges are located on the instrument panel in front of the engineman. In general, the cab air brake equipment consists of the automatic brake valve, the independent brake valve and the K-2-A Rotair valve, a manually operated valve having four positions and located to the right of the controller as shown in Fig. 1-1. The automatic brake valve handle has 6 positions — release, running, first service, lap, service and emergency; and may be of the rigid or hinged handle type. The automatic brake valve handle (rigid or hinged handle) is removable in the running position. The handle should be removed when a double cab locomotive is being operated from the opposite end. The hinged handle, if required by the railroad, is used to suppress a safety control from the foot pedal by depressing the handle to a horizontal position. On some railroads a sanding bail provides sanding by further depressing the handle.

The brake valve, Fig. 1-3, also contains:

1. Brake valve cutout cock, located on the filling piece portion.
2. Safety control cutout cock, located on the service application portion.
3. First service position cock.
4. Full release selector cock.

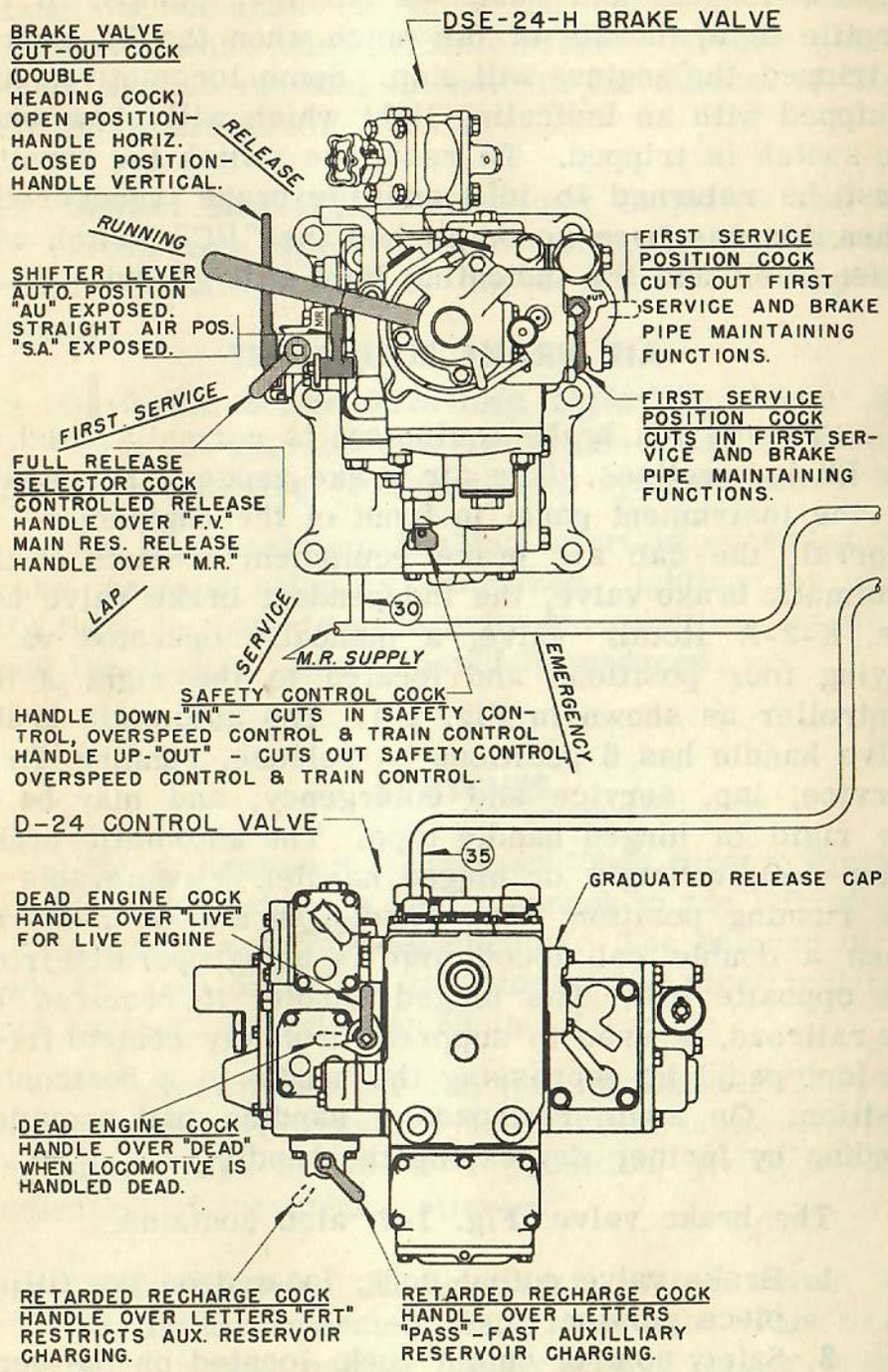
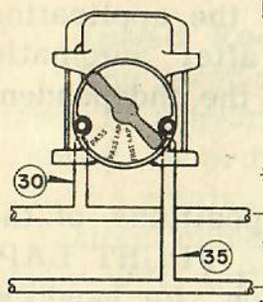

DSE-24-H BRAKE VALVE
BRAKE VALVE CUT-OUT COCK (DOUBLE HEADING COCK) OPEN POSITION- HANDLE HORIZ. CLOSED POSITION- HANDLE VERTICAL.
RELEASE
RUNNING
SHIFTER LEVER AUTO. POSITION "AU" EXPOSED. STRAIGHT AIR POS. "S.A." EXPOSED.
FIRST SERVICE
FULL RELEASE SELECTOR COCK CONTROLLED RELEASE HANDLE OVER "F.V." MAIN RES. RELEASE HANDLE OVER "M.R."
LAP
SERVICE
EMERGENCY
M.R. SUPPLY
30
FIRST SERVICE POSITION COCK CUTS OUT FIRST SERVICE AND BRAKE PIPE MAINTAINING FUNCTIONS.
FIRST SERVICE POSITION COCK CUTS IN FIRST SERVICE AND BRAKE PIPE MAINTAINING FUNCTIONS.
SAFETY CONTROL COCK
HANDLE DOWN-"IN" - CUTS IN SAFETY CONTROL, OVERSPEED CONTROL & TRAIN CONTROL
HANDLE UP-"OUT" - CUTS OUT SAFETY CONTROL, OVERSPEED CONTROL & TRAIN CONTROL.
D-24 CONTROL VALVE
35
GRADUATED RELEASE CAP
DEAD ENGINE COCK HANDLE OVER "LIVE" FOR LIVE ENGINE
DEAD ENGINE COCK HANDLE OVER "DEAD" WHEN LOCOMOTIVE IS HANDLED DEAD.
RETARDED RECHARGE COCK HANDLE OVER LETTERS "FRT" RESTRICTS AUX. RESERVOIR CHARGING.
RETARDED RECHARGE COCK HANDLE OVER LETTERS "PASS"-FAST AUXILLIARY RESERVOIR CHARGING.

Fig. 1-3

K-2-A ROTAIR VALVE



HANDLE OVER LETTERS "FRGT"
CUTS IN CONTROLLED EMERGENCY FEATURE, SPLIT SERVICE REDUCTION, & INDEPENDENT BRAKE VALVE.

HANDLE OVER LETTERS "FRGT LAP" *
CUTS OUT INDEPENDENT BRAKE VALVE. CONTROLLED EMERGENCY STILL IN EFFECT.

HANDLE OVER LETTERS "PASS LAP" *
CUTS OUT CONTROLLED EMERGENCY & THE INDEPENDENT BRAKE VALVE.

HANDLE OVER LETTERS "PASS"
ALL FEATURES REMAIN CUTOUT AS IN "PASS LAP," EXCEPT INDEPENDENT BRAKE VALVE IS CUT IN.

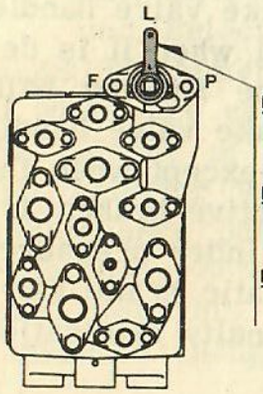
* POSITION USED FOR TRAILING "A" UNITS.

TO INDEPENDENT BRAKE VALVE

"B" UNIT CONTROL VALVE SECTION.

NOTE: WHEN DOUBLE HEADING, THE ROTAIR VALVE ON THE SECOND OPERATING UNIT SHOULD BE LEFT IN A LIVE POSITION, "FRGT" OR "PASS", TO RETAIN USE OF INDEPENDENT BRAKE VALVE.

WHEN OPERATING A "B" UNIT ALONE WITH THE HOSTLER'S CONTROL, THE CONTROLLED EMERGENCY SELECTOR COCK MUST BE PLACED IN "PASS" POSITION TO EFFECT QUICK ACTING EMERGENCY IF NEEDED.



HANDLE OVER "F"
CUTS IN CONTROLLED-EMERGENCY BRAKE CYLINDER PRESSURE DEVELOPMENT FEATURE.

HANDLE OVER "L"
POSITION NOT USED WITH OUR EQUIPMENT. HANDLE MUST BE IN PASSENGER OR FREIGHT POSITION.

HANDLE OVER "P"
CUTS OUT CONTROLLED-EMERGENCY BRAKE CYLINDER PRESSURE DEVELOPMENT FEATURE.

VIEW OF PIPE BRACKET FOR CONTROL VALVES
SHOWING CONTROLLED-EMERGENCY CUT-OUT COCK IN "B" UNITS

Cock Handle Positions
24 RL Brake
All Types Of Service
Fig. 1-3

115 **Independent Brake Valve** The S-40-F independent brake valve handle has two positions, release and full application, with the application zone between the two positions. The brake valve is of the self-lapping type which automatically laps off the flow of air and maintains brake cylinder pressure, when the application pressure reaches the value corresponding to the position of the brake valve handle in the application zone. Release of locomotive brakes after automatic application is obtained by depressing the independent brake valve handle in release position.

116 **K-2-A Rotair Valve** The four positions of the K-2-A Rotair valve are "FRGHT," "FRGHT LAP" "PASS LAP" and "PASS." See "Operation" for handling of this valve.

117 **Safety Control Foot Pedal** The safety control foot pedal is located in front of the engineman's seat. On locomotives equipped with the DS-24-H brake valve, having the hinged automatic brake valve handle, the handle provides an alternate control when it is depressed sufficiently to just contact the sanding bail. Either the pedal or the automatic brake valve handle must be kept depressed at all times except when the locomotive is stopped and the locomotive brakes are applied (30 pounds or more brake cylinder pressure). If both the foot pedal and the automatic brake valve are released at the same time, a penalty application of the brakes will result.

MISCELLANEOUS EQUIPMENT

118 **Sanding Valve** When the locomotive is equipped with the hinged automatic brake valve handle, sanding is accomplished by depressing the lever beyond

the safety control position previously described. This movement operates the sanding bail which opens a port to supply air to the sanding equipment. On locomotives having a rigid handle on the automatic brake valve, an independent sanding valve is installed. This lever is operated by pushing the lever forward until it latches.

119 **Speed Recorder Locomotive Overspeed Control** The speed recorder, located in front of the control stand, is a hydraulically operated speed indicator with a speed recording tape and an odometer. It is driven from the number 1 idling axle of the "A" unit, through a flexible cable. It contains a maximum speed device which will initiate a full service application of the brakes and trip the PC switch when the maximum speed setting is exceeded. On some railroads, instead of a full service application of the brakes, the brakes go into emergency.

120 **Unit Selector Switch** (Dynamic Brake Only) The unit selector switch located next to the engineman's instrument panel has four positions, only three of which are used, and should be set corresponding to the number of units making up the locomotive. The unit selector switch should be set before leaving the maintenance point. If one or more engines should be isolated en route, this switch must not be changed. The only time this switch is changed is if the locomotive consist is changed.

121 **Windshield Wipers** The windshield wipers are controlled by valves, one of which is located on the engineman's instrument panel, and one on the panel on the fireman's side of the cab. These wipers operate independently of each other. The wipers should not be run on a dry window as dirt on the glass or blade will scratch the glass.

122 **Horn Valves** The horns are operated by air valves which are controlled by pull-cords, above the control stand. The horn shut-off valve is located in front of the No. 2 main reservoir.

123 **Locomotive Bell** The locomotive signal bell is under the locomotive floor behind the pilot on the left side. It is operated by an air valve located at the engineman's station.

124 **Cab Heater** A cab heater is located on each side of the cab. Steam from the steam line passes through the heaters and motor driven fans provide air circulation. The output of each heater can be varied by use of the cab heater switches. The switches have four positions "OFF" 1, 2, 3, which provide three different motor speeds.

125 **Defrosters** Each side of the cab is equipped with a defroster motor and fan which blows heated air on the inside of the front cab windows. Both motors are turned on and off by the one defroster switch in the control push-button switch box.

126 **Classification Lights** A permanently fixed, clear bull's-eye is provided on each side of the nose. Inside the nose and behind each bull's-eye, a small compartment contains the classification light bulb and colored lenses. Red and green lenses are provided in each compartment which can be moved into a position between the bulb and the bull's-eye. To accomplish this, a locking pin is removed, the desired lens swung into place and the locking pin replaced. The lenses are accessible from the inside of the nose section through hinged doors in the compartments. When both red and green lenses are out of position the permanent bull's-eye lens will show a white light, thus making three colors available.

ENGINE ROOM

The two ends of the engine are designated "FRONT" and "REAR" as shown in Fig. 1, which will serve to identify the cylinder locations, ends and sides of the engine, as they are referred to in this manual. The governor, water pumps, and lubricating oil pumps are on the "FRONT" end. The blowers, oil separator and generator are mounted on the "REAR" end.

The engines are mounted so the rear end of No. 1 engine is toward the front of the unit and the rear end of No. 2 engine is to the rear of the unit.

As No. 1 engine is mounted backward, the right side of the engine is on the left side of the unit.

127 **Engine Control and Instrument Panel** This panel, Fig. 1-5, is mounted on a frame which supports the engine cooling water tank near the governor end of each engine. Each power plant has its own engine control and instrument panel on which are mounted the lube oil pressure and suction gauges, and signal lights, along with the start, stop, fuel pump and isolation switches.

128 **Isolation Switch** This switch has two positions "START" (handle horizontal) and "RUN" (handle vertical).

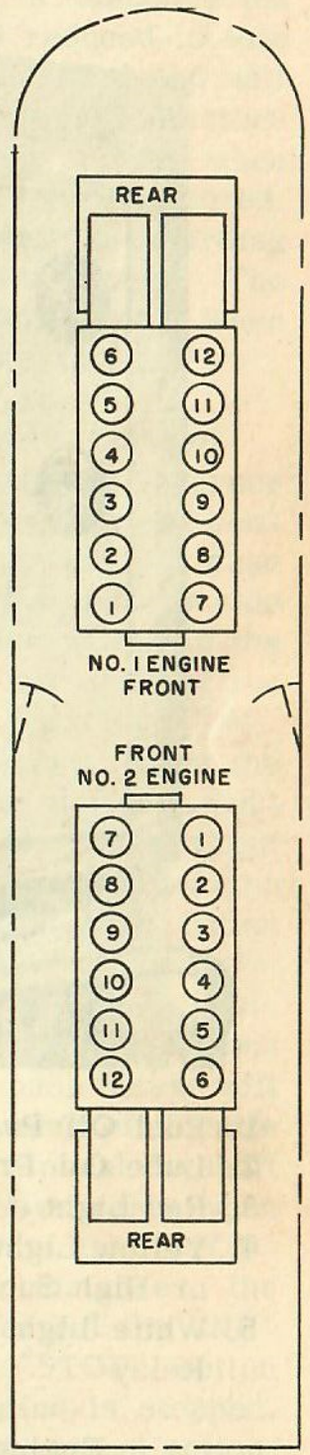
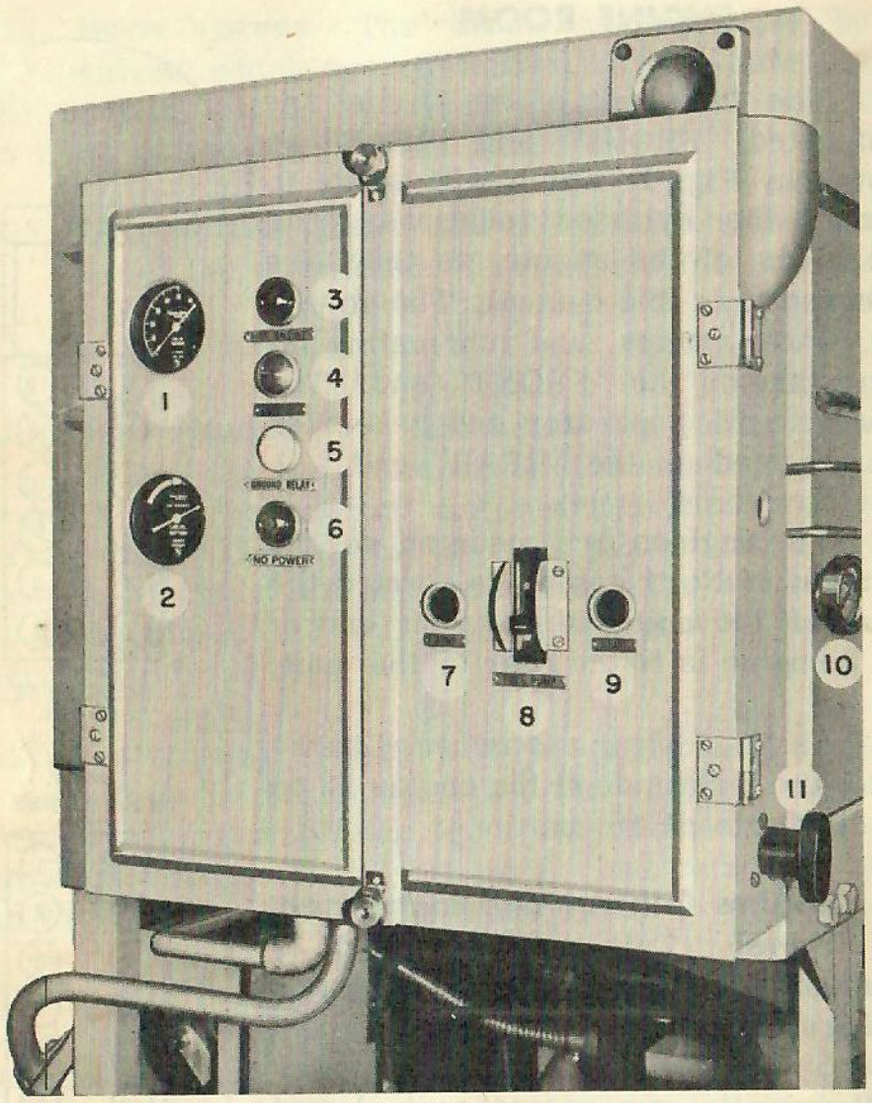


Fig. 1-4



1. Fuel Oil Pressure
2. Lube Oil Pressure
3. Red Light — Hot Engine
4. Yellow Light — Low Oil or High Suction
5. White Light — Ground Relay
6. Blue Light — No Power
7. Engine Stop Button
8. Fuel Pump Switch
9. Engine Start Button
10. Isolation Switch
11. Cooling Water Inlet Temperature

Engine Control And Instrument Panel
Fig. 1-5

In "START" position, the power plant is disconnected from the control circuit, and engine is reduced to idle speed. The engine will remain at idle speed and will not respond to throttle control. The power contactors in the electrical control cabinet will not operate when the throttle is opened or the transition lever is moved. In dynamic braking the unit will exert no retarding effect. The "NP" (no power) alarm is inoperative. The "START" and "STOP" buttons are effective only when the isolation switch is in "START" position.

129 Governor, Governor Speed, Safety Control

Each engine is equipped with a Woodward Governor which includes an electro-hydraulic governor speed control, and an unloader used during transition. In case of low oil pressure or high vacuum on the suction side of the lube oil pump, the engine governor will stop the engine. The alarm bells will sound in all units of the locomotive. The yellow "LOW OIL" and the blue "NP" signal light will show on the engine affected. When the governor safety control stops the engine, the push button on the front of the governor housing moves out approximately 3/8" exposing a red band around the shaft of the button. The governor reset push button must be pressed in to extinguish the "LOW OIL" alarm lights and the isolation switch moved to "START" position to extinguish the "NP" alarm lights. Both actions are necessary to stop alarm bells. The push button will not trip if the engine stops due to placing of throttle in emergency stop position, operation of manual layshaft control lever, tripping of ground protective relay when throttle is in run 5 or run 6, or use of the "STOP" button for normal shutdown. In these instances, the "LOW OIL" alarm lights will not light but the "NP" alarm will function (except when the "STOP" button is used) to serve as a warning that an engine is stopped. When the engine is stopped by governor control action, the push button must be reset before the engine can be

started. When the engine is started and run at idling speed, the governor will stop the engine again after approximately forty seconds, if the condition still exists which caused the original shutdown. This time delay is provided to allow a check to determine the cause of the shutdown. However, if an attempt is made to run the engine above idling speed during the delay period, the governor will stop the engine at once should the oil pressure be low or the oil pump suction be high.

130 **Electrical Control Cabinet** The electrical control cabinets contain the various contactors, relays, and other equipment necessary for the electrical and electro-pneumatic control of the unit.

131 **Control Air Pressure Regulator** The "control air" for operating power contactors, reverser and cam-switch is supplied from the main reservoir and reduced to 80 $\pm$ 3 pounds by the control air pressure regulator. The pressure regulator is located behind the steps leading into the operating cab on the right (engineman's) side of the locomotive. The pressure is indicated on a gauge mounted on each of the electrical control cabinets.

132 **Load Regulator** The load regulator is located below the engine control panel, its movement is controlled by a pilot valve and a dump valve in the engine governor. The load regulator controls the loading of the main generator, and automatically maintains a constant horsepower output, corresponding to each throttle position throughout the entire range of engine speed.

133 **Layshaft Manual Control Lever** The layshaft manual control lever is attached to the end of the injector layshaft, at the left front corner of the engine and is accessible when standing at the engine control panel. It may be used to shut engine down manually,

or to bring the engine speed to idle, as when taking an engine "off the line." It is also used to increase engine speed gradually when putting an engine "on the line," when locomotive is under power.

134 **Indicators, Gauges And Protective Devices** After the engines are started the entire operation of the locomotive may be conducted from the cab. Protective devices, alarm bells, and signal lights are installed in the locomotive to provide the maximum protection for the equipment.

There are a number of indicators, gauges, and protective devices which should be observed when inspecting the engine room. Additional protective devices and indicators are installed in the locomotive which should be checked when abnormal operation (trouble) is encountered.

135 **Engine Overspeed Trip** If the engine speed exceeds approximately 910 RPM, an engine overspeed device, located on the front of each engine behind the engine governor, see Fig. 5-9, Section 5, will trip and bring the engine to a stop.

136 **Hand Brake** The hand brake is located in the steam generator compartment, on left side of locomotive. To set the brakes, the brake handle is pumped up and down. To release brake, raise up on release lever, to the left of brake lever. Before moving the locomotive, be sure the brakes are completely released. Whenever anyone is working around the locomotive trucks, the hand brakes should be applied.

NOTES

SECTION 2

NORMAL OPERATION

Successful road operation and dependable function of all E8 locomotive components are entirely dependent upon quality of inspection and repair at regular maintenance periods, as well as the proficiency of the operating crew. As a supplement to terminal maintenance, a "pre-service check" by the engine crew upon boarding the locomotive will generally preclude the necessity of anyone entering the engine room while under way.

It is strongly recommended that the items listed below be checked thoroughly and without omission, for carelessness is most often the cause of road failures which cause unnecessary delays.

PRELIMINARY

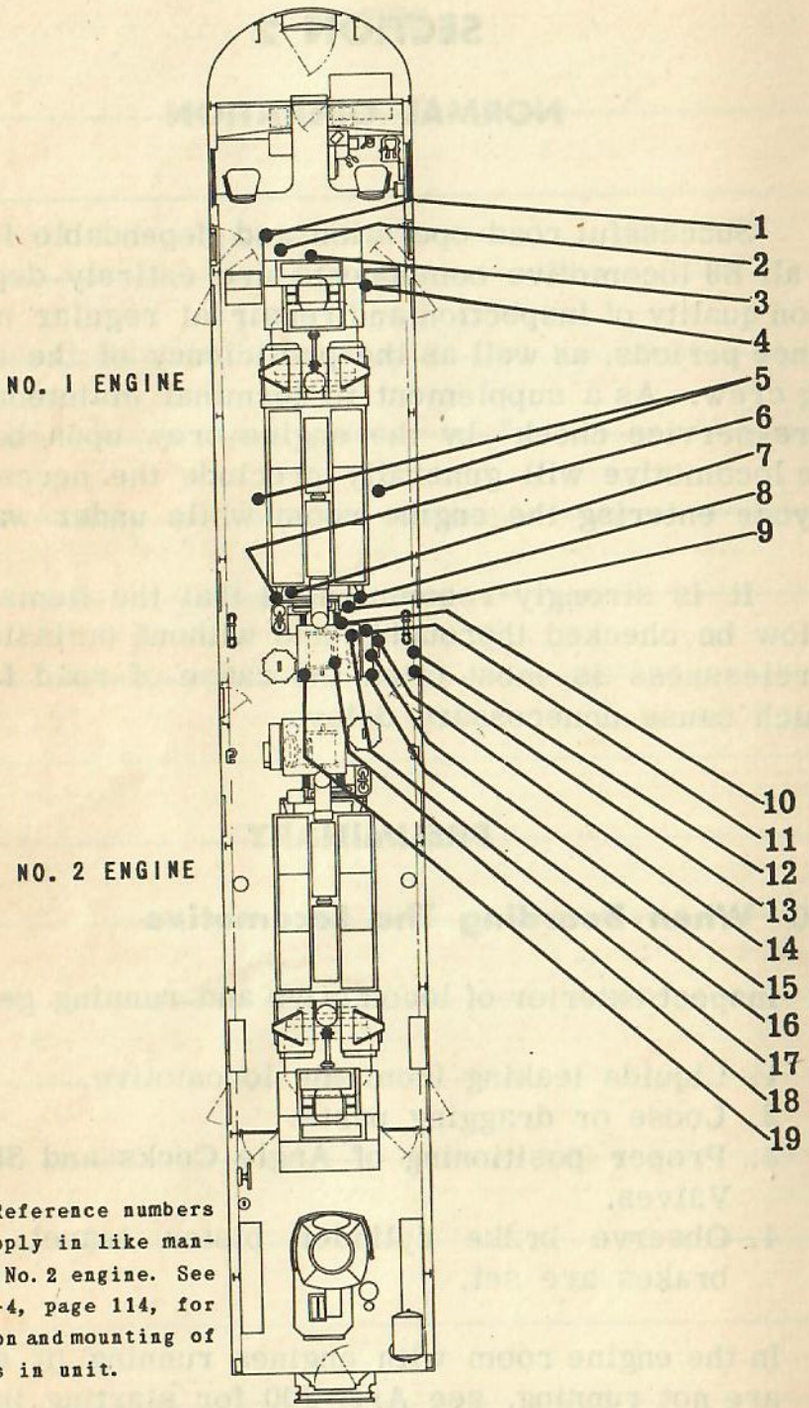
200 **When Boarding The Locomotive**

A. Inspect exterior of locomotive and running gear for:

1. Liquids leaking from the locomotive.
2. Loose or dragging parts.
3. Proper positioning of Angle Cocks and Shut-Off Valves.
4. Observe brake cylinder piston travel, if air brakes are set.

B. In the engine room with engines running (if engines are not running, see Art. 300 for starting instructions), the following check is to be made in all units.

1. Check for oil, water and fuel leaks.



NOTE: Reference numbers also apply in like manner to No. 2 engine. See Fig. 1-4, page 114, for location and mounting of engines in unit.

Location Of Gauges, Relays And Equipment
Fig. 2-1

ENGINE ROOM CHECK CHART

	Item	Reading		Ref. Art No.	Unit Failure Check
		Idle	800 RPM		
1	Aux. Gen. Ammeter	20	20+	316	B
2	Starting Contactors	Not Stuck St. Position		317	X
3	Ground Relay	Yellow		319	X
4	Control Air Pressure	80 ± 3		318	X
5	Lube Oil Level	Run Level		401	
6	Fuel Flow	Thru Glass Nearer Engine		325	X
7	Overspeed Trip	Latched (Pull to Set)		326	B
8	Eng. Speed & Fuel Ind.	Pointers as in Fig. 5-10		322	X
9	Gov. Oil Level	Between Lines			
10	Water Pressure	0 to 5	25 to 35		R
11	Isolation Switch	"RUN"		323	X
12	Fuel Supply Gauge	As Needed			X
13	Gen. Water Supply	As Needed			
14	Load Regulator	Same as other units		324	X
15	Lube Oil Pressure	6# Min.	30# to 45#	403	YB
16	Lube Oil Suction	Green		129	YB
17	Water Temperature	125° Min.	165° ± 15°	400	R
18	Air Comp. Oil Pres.	5#	15#		
19	Water Level Gauge	Between Lines		400	R
* 20	Main Reservoir	130 to 140			
* 21	Air Comp. Intercooler (If Used)	30# When Pumping			

FAILURE CHECK. Should a unit fail to perform properly check items lettered as "X." The letters R, B, YB, indicate items that will cause Red, Blue, or Yellow and Blue lights to come on. See Art. 311 for details.

*Not Shown

Fig. 2-1

2. Check gauges, indicators and switches as listed in Fig. 2-1.
3. Drain condensation from air brake system.
4. Check position of "Controlled Emergency Cock" on the D-24 control valves in all "B" units. The position of this cock should correspond with the setting of the Rotair valve in the operating cab, "PASS."
5. In cab of trailing "A" unit, set Rotair valve in "PASS LAP" position and see that brake valve is properly cut out. Place transition lever in "OFF" position.
6. When returning back through each unit, check and release hand brake in each unit.

NOTE: It is good practice to check the auxiliary generator output ammeter on the electrical control cabinet of each power plant to see that the auxiliary generator is charging. This ammeter should show zero or some charge with engine running.

C. In the cab

1. Check brake valve cut-out cock and Rotair valve position, "PASS."
2. Install reverse lever, move to desired direction, either "forward" or "reverse."
3. Place transition lever in "POWER" position. To move transition lever, lift as high as it will go, and press firmly in direction you desire to move the lever. Maintain this side pressure and lower the lever, it will slip into position.
4. If locomotive is equipped with dynamic brake, check position of unit selector switch to correspond with number of units of locomotive.
5. Push in "Generator Field" switch.

201 Handling Light Locomotives

A. Running light (Complete cab preparation Art. 200, Item C).

1. Place foot on safety control foot pedal.
2. Release independent brake.
3. Open throttle one notch at a time. To open throttle, jerk it gently one notch and release. This will permit the lever to set itself for the next notch.
4. NOTE THAT LOCOMOTIVE ROLLS FREELY AND CARE SHOULD BE USED IN JUDGING THE SPEED.
5. Close throttle to idle before setting brake.
6. Locomotive must be standing still at the time the reverse lever is moved.

B. Coupling to train

1. Locomotive must not be moved with air hoses hanging free on nose of "A" units.
2. In backing onto a train it may be desirable to use the attendant's call in rear "A" unit or train signal whistle valves at rear of "A" and "B" units for signalling.
3. Valves and cocks.
   a. Nose angleccock is behind pilot on fireman's side.
4 b. Steam line valve behind pilot on engineman's side. Lower edge of pilot must be secured in raised position to connect steam train line.
   c. Train line signal whistle shut-off valve in nose compartment directly ahead of engineman. It is on signal line reducing valve at front center of brake rack.

C. Pumping up air

1. Pull out generator field switch.
2. Place reverser in neutral.
3. Open throttle to 4th, 5th, or 6th notch as needed.

202 **Splitting And Joining Units**

1. Take down all jumpers (inside and outside the diaphragm).
2. Close angle cocks on both units on all air hoses.
3. Break hoses and separate units by uncoupling.
4. In joining units.
   a. Stretch units to insure couplers are locked.
   b. Connect hoses and jumpers, and be sure all angle cocks on all air hoses are opened in both units.
   c. CUT OUT BRAKES, AND ALL CONTROL SWITCHES IN ALL BUT THE OPERATING UNIT. Remove reverse lever in trailing "A" unit.

HANDLING A TRAIN

203 **Starting** (recheck cab preparations, Art. 200, Item C).

It would be practically impossible to write definite instructions for train starting that would apply to all conditions and at all times. From long observation, the following instructions have been written in an attempt to assist the engineman that has not had a previous opportunity to operate Diesel-Electric locomotives.

It will be noticed that the locomotive does not respond as soon as the throttle is opened. In fact, it may take a few seconds before the locomotive will

start to move. This is due to the fact that the load regulator arm is resting in the minimum field position. By this it is meant that the total amount of resistance is in the generator battery field circuit, reducing the generator field excitation to a minimum.

As the throttle is opened to run one, the pilot valve in the engine governor becomes unbalanced, causing engine lube oil to flow to the vane motor of the load regulator, causing the arm to move toward the maximum position. As the arm moves towards maximum field position (8 o'clock), resistance is cut out of the generator battery field circuit, increasing the generator excitation, increasing generator output to start the locomotive or train.

Locomotives, when delivered, are adjusted so that the increase of power output is controlled by the load regulator and governor rather than by the throttle. Thus, although the throttle lever is opened rapidly, the rate of power increase will be controlled by the load regulator and governor, and a smooth start assured.

When ready to start, place foot on safety control pedal, release brakes and open throttle quickly to Run 3. Observe the load indicating meter. If train does not start when pointer passes 500 amperes, open throttle another notch. With a very heavy train, or when starting on a grade, the pointer may govover to full scale before the train starts.

It is permissible to keep the pointer at full scale while train is accelerating. As soon as the pointer starts back to the left, open throttle another notch. Continue in this manner until throttle is full open, or until desired speed has been attained.

The following instructions have been written as

guidance for the engineman so he may get the most out of the locomotive and still not overload the electrical equipment, when operating the "E" class passenger locomotives in mountainous territory, where the locomotive must negotiate long continuous grades.

Speed at which forward transition is made, series to parallel, full throttle:

Gear Ratio	MPH
52/25	29
55/22	24
56/21	23
57/20	21

Minimum continuous miles per hour in parallel:

Gear Ratio	MPH In Throttle Position 5	6	7	8
52/25	15	22	29	37
55/22	12	18	24	31
56/21	11	17	23	29
57/20	10	16	21	27

Speed at which backward transition is made, parallel to series, full throttle:

Gear Ratio	MPH
52/25	27
55/22	23
56/21	21
57/20	20

For this example, the 52/25 locomotive has been selected. All other gear ratios should be handled the same at their respective speeds.

On a long continuous ascending grade, if the locomotive speed drops below 40 MPH, the throttle should be reduced to Run 7. As the locomotive speed slows to less than 33 MPH, the throttle is reduced to Run 6. If locomotive speed continues to decrease, and gets below 27 MPH, close throttle quickly to idle, and open again to Run 8. This action changes the motor connections to series. Enginemen generally know their railroad thoroughly. If the locomotive speed picks up and approaches 34.5 MPH, and there are several miles of ascending grade ahead, the throttle should be reduced to Run 7 to prevent undesired forward transition. As the grade decreases, or the top of the hill is nearly reached, open the throttle to Run 8 to allow forward transition to parallel.

204 Accelerating A Train

1. After the throttle is in the 8th notch, the indicating meter pointer should move slowly toward the left. If the pointer is in the overload area, it must continue to move until it is in the green area, or the locomotive is overloaded.

BRAKING

205 **Air Braking With Power** Under certain conditions it may be desirable to keep train stretched during a slow down or stop. If this is done, the throttle should be closed to at least the 6th notch and the independent brake kept fully released. As the train speed decreases, the throttle must be eased off. As the train slows down, the pulling power of the locomotive increases rapidly and might become great enough to part the train if the throttle is not reduced. The throttle should be in "idle" before the locomotive comes to a dead stop.

206 **Dynamic Braking** To use the dynamic brake see that the unit selector switch located next to the instrument panel is set to correspond with the number of units in the locomotive consist. Place the throttle in "idle," and move the transition lever to first braking position. (The reverse lever must be in either forward or reverse to operate dynamic brake). If the train is moving at considerable speed, enough brake may be developed in this position to bunch the slack. As the lever is moved to the right beyond the first braking position, the main generator field is strengthened, increasing the braking effort. The dynamic brake is in effect an independent brake and the load indicating meter is now acting as a "brake cylinder pressure gauge."

The same precaution must be used in controlling slack as with the independent brake of the locomotive. After the slack is bunched the lever may be moved to give the desired amount of brake. The pointer must not be carried beyond the red triangle on the indicating meter (THIS SHOULD NOT BE CONFUSED WITH RED DIAMOND), nor must the dynamic brake warning light be permitted to stay lit. In either case, ease off slightly on the brake until these conditions are remedied.

Differences in idling speed of the engines and variation in the motor and generator characteristics may cause the dynamic brake warning light to come on before the meter pointer reaches the red triangle, but in any case, the light must not be on. The light is an indication of an overload, and operating with it on might damage the traction motors and braking grids.

The independent brake must be kept fully released at all times when the dynamic brake is in use, or the wheels may slide. As the speed decreases below 15 miles per hour the dynamic brake becomes less effec-

tive. When the speed decreases further it is permissible to completely release the dynamic brake by placing the transition lever in "OFF" position, and apply the independent brake simultaneously to prevent the slack from running out.

Whenever desirable the automatic brake may be used in conjunction with the dynamic brake provided the independent brake is KEPT FULLY RELEASED.

The most effective use of the dynamic brake is between 20 and 30 miles per hour depending on the gear ratio. Speed on grades should not be allowed to "creep up" by careless handling of the brake, as this is a holding brake and is not effective for slowing down heavy trains on steep grades.

MISCELLANEOUS OPERATING INSTRUCTIONS

207 **Operation Over Railroad Crossings** When crossing railroad crossings, reduce throttle to the 5th notch before reaching crossing and leave reduced until all units are over crossing in order to reduce arcing from the brushes to the motor commutator.

208 **Changing Operating Ends** When the consist of the locomotive includes two "A" units, the following procedure should be followed in changing from one operating end to the opposite end:

1. REMOVE REVERSE LEVER.
2. Place transition lever in "OFF" position.
3. With safety control foot pedal depressed, release independent air brake by placing independent brake valve handle in "release" position.
4. Make full service automatic brake reduction.
5. Close brake pipe cutout cock and release safety control foot pedal.

6. Move the Rotair valve to the proper "LAP" position.
7. Move the automatic brake valve handle to "RUNNING" position and remove the handle from the brake valve.
8. Remove the independent brake valve handle in "RELEASE" position.
9. Place and lock generator field, control and fuel pump circuit breakers in control stand in "OFF" position. The electro-pneumatic circuit breaker (if used) on the electrical control cabinet behind the fireman should also be in "OFF" position.
10. Proceed to cab at opposite end. Check "PC" switch and reset if necessary. Open switch lock on control push-button switch box, close control and fuel pump switches and such other switches as are necessary.
11. Insert reverse lever, automatic brake valve and independent brake valve handles. Place independent brake valve in "full application" position.
12. Move the Rotair valve to the proper operating position.
13. Open brake valve cutout cock (double heading cock) slowly, pausing from five to ten seconds in mid-position.
14. When ready to move locomotive, depress safety control foot pedal or automatic brake valve handle, and move the independent brake valve to "RELEASE" position.

209 **Operating "B" Unit With Hostler's Controls** Operation at the hostler station is the same as an "A" unit. The push-button switches are beside the controller. The brake valve cutout cock is below the brake valve. The bell valve is a globe valve near the controller. It is to be remembered that the operation of the "B" unit controls will operate all units joined to it.

When securing the hostler control be sure all push buttons are pulled out, the controller and reverser pinned, and the brake valve cut out, as these items will affect operation at any other station or cab.

210 **Leaving Locomotive** Officials of the Mechanical Department of the various railroads generally issue instructions of this nature that will apply to their own individual requirements, as conditions will vary with each different railroad, and in a good many instances between different localities on the same railroad.

211 **Air Box Drains** Each engine has two air box drain tanks incorporated in the engine oil pan near the generator end, one on each side. These tanks have a valve in the drain line so that the tanks may be drained when the locomotive is standing still, and sludge and oil from the tank will not be carried onto the running gear.

212 **Unusual Operating Conditions** Unusual operating conditions such as overloading, running through water, failure of indicating meter, isolating units etc., are covered in Section 3.

NOTES

SECTION 3

SPECIAL CONDITIONS AND PROBLEMS DURING OPERATION

There are several conditions which may be encountered from time to time which require special operating instructions. If the instructions are closely followed no damage to the equipment will result. Careless operation under these specialized conditions can be very costly.

300 Starting Engines

A. In Operating Cab

1. Close all switches in electrical control cabinet.
2. At engineman's station close "control" and "fuel pump" switches.
3. Place independent brake in full "application" position.
4. Check "PC" switch.
5. BE SURE REVERSE LEVER IS REMOVED FROM CONTROL STAND.

B. In Engineroom

1. Check main battery switch box, located to the left of hand brake in steam generator compartment.
2. Check boiler transfer switch at top of panel in No. 2 electrical control cabinet. This is a large double-pole, double-throw knife switch. The normal position of this switch is to the right, connecting both auxiliary generators and steam generator to the battery circuit.

With extreme conditions, it may be possible that unsatisfactory steam generator operation may result

with the switch thrown to right, due to low voltage at the steam generator. Proper voltage for steam generator can be obtained by throwing boiler transfer switch in No. 2 electrical cabinet to the left. The following procedure MUST be observed when changing position of the boiler transfer switch in order to prevent personal injury and damage to the switch:

a. Isolate the No. 2 engine.
b. Turn boiler control switch to "off."
c. Open the No. 2 auxiliary generator circuit breaker.
d. Throw the transfer switch.
e. Close the No. 2 auxiliary generator circuit breaker.
f. Start the steam generator.
g. Place the No. 2 isolation switch in "run" position.

If either auxiliary generator should fail, that particular power plant is out of operation, as the main generator battery fields cannot be excited by the batteries when battery charging contactor is open.

3. Check engine lube oil and water levels and oil level in governor and air compressor.
4. Test signal alarm system by placing isolation switch in "Run" position momentarily. Blue light should light and bells should ring.
5. If engine has been shut down more than two hours, open cylinder test valves, pull lay shaft closed and press "START" button on engine control panel. Crank engine over a few revolutions. If water was discharged from cylinders investigate, if not, close test valves and proceed.
6. Turn on fuel pump switch and check for fuel flow through sight glass on fuel filter nearest engine (mounted on the right front of engine).
7. Check setting of overspeed trip (pull to set).
8. Check governor oil alarm trip button.
9. Hold layshaft one quarter open.

10. Press engine start button until engine starts (not more than fifteen seconds).
11. Check oil pressure.
12. Check ground relay.
13. Check starting contactor interlocks.
14. Idle engine until water temperature comes up to green area on gauge before working engine.
15. Place isolation switch in "Run" position (vertical).
16. For starting troubles, see Section 5.

301 **Stopping Engines** (For stopping while under power, see Art. 312.

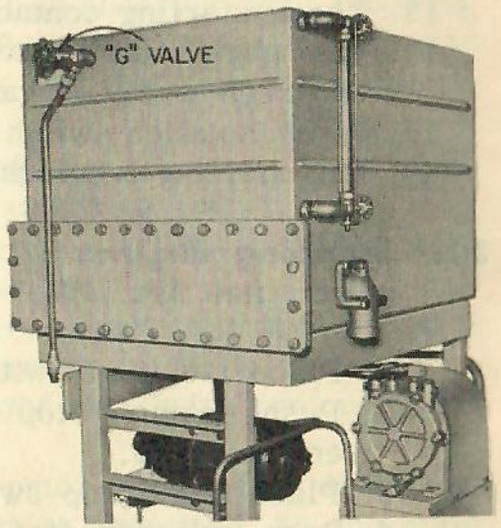
1. Place isolation switch in "start" position.
2. Push engine "stop" button in and hold it until engine stops.
3. Place fuel pump switch in "off" position.
4. Open cylinder test valves on engine (if more than two hour layover).

302 **Securing Locomotive At Engineman's Control Station In Preparation For Layover**

1. Place transition lever in "off" position.
2. Place reverse lever in "neutral" position and remove lever from controller.
3. Open all control switches at engineman's control station.
4. Release air brakes and set hand brake. As an added precaution against locomotive moving, block the wheels.

304 **Freezing Weather Precautions** In freezing weather, precautions must be taken to see that water in the locomotive does not freeze. If one or more engines are shut down while on the road, during extremely cold weather, open the steam admission valve, admitting steam to the engine affected.

The "G" valve, Fig. 3-1, on the water tank of each power plant shut down, should be opened to drain out the condensate formed in the engine, to prevent the cooling radiators from freezing.



Oil Cooler And Water Tank
Fig. 3-1

If train line steam is not available, the cooling system will have to be drained. Open drain valve on engine, "G" valve on water tank and remove pipe plug from right hand water pump on front of engine, Fig. 5-3. If necessary, drain toilet water tank.

If a unit is to be left outdoors in freezing weather with all engines and the steam generator shut down, and no yard steam available, the unit will have to be drained completely, as follows:

1. Engine cooling system.
   a. Open drain valve on each engine.
   b. Open "G" valve on each water tank.
   c. Remove pipe plug from bottom of right hand water pump on each engine.
2. Steam generator. (See Steam Generator Section)
3. Steam generator water tank.
4. Toilet water tank.
5. Air system.
   a. Air compressor oil separator.
   b. Air compressor governor.
   c. Air compressor intercooler (if used).
   d. Aftercooler discharge filter.
   e. "H" type filter.

   f. "J" type filter.
   g. Control air regulator.
   h. Control air reservoir.
   i. Control air strainer.
   j. No. 1 main reservoir.
   k. No. 2 main reservoir.
   l. Main reservoir equalizing line blowout valve.

305 **Towing Locomotive**

1. Be sure reverse lever is in neutral position. If locomotive is to be towed in a train any appreciable distance, the reverser switch must be placed in neutral and locked in that position. To lock the reverser switch, remove the locking pin which during normal operation is screwed into the left hand side of the reverser housing. With the reverse lever in neutral, punch the buttons on top of reverser switch lightly, to center. (If control air is not available, place wrench on square portion of switch shaft and center switch manually). After switch has been centered, shut off control air. Insert pin into hole in the right side of reverser housing, pushing pin all the way through the reverser switch shaft, and screw pin into threaded hole on left side of reverser housing.
2. All isolation switches must be in "START" position. If it is necessary to keep the engines idling for any reason while towing locomotive, the fuel pump and control switches should be left in the closed position.
3. The air brake equipment should be set according to the air brake manufacturer's bulletin.

306 **Operating Without Load Indicating Meter** The load indicating meter, calibrated in amperes (current), is mounted on the instrument panel in front of the engineman, and shows traction motor current.

As this meter is connected into the armature lead of No. 2 traction motor, it shows the amount of current going through both motors when they are connected in series. This is equal to the main generator output in amperes.

When the motors are connected in parallel, the meter shows the current going through No. 2 motor only, but, as No. 1 motor is in parallel with No. 2 motor, an equal amount of current is passing through No. 1 motor. The current now shown on the meter is one half the main generator output in amperes.

Transition on the E8 locomotive is fully automatic forward from 1 to 2 to 3 and automatic backward from 3 to 2, with no provision made to effect this transition manually; consequently, there are no transition areas on the load indicator dial.

Backward transition from 2 to 1 is made when the locomotive speed has decreased as shown on table:

Gear Ratio	Speed MPH
52/25	27.5
55/22	23.0
56/21	21.5
57/20	20.0

To make backward transition from 2 to 1, the throttle MUST be closed to idle and opened again. If the throttle is not closed to idle, the motors will stay in parallel, even though the locomotive is brought to a standstill.

After the throttle has been opened, the motor connections will change to parallel (No. 2 position) automatically when locomotive speed has reached approximately 30 MPH, with throttle in Run 8. Even though

the locomotive may be rolling down hill at high speed, the throttle must be opened wide to effect transition to parallel, and then reduced to maintain desired speed.

If No. 1 engine has been isolated or shut down, the load indicating meter will be inoperative. Under this condition, the locomotive will have to be operated by the speed recorder for minimum continuous operation.

307 Operating With Steam Locomotive As Helper

The speed of passenger trains in mountainous country is generally limited between 30 to 45 MPH, depending on track curvature and grade. In order to maintain a maximum speed of long heavy passenger trains, consistent with safety and passenger comfort, a helper locomotive is generally used over long continuous mountain grades.

Where practicable, it is generally advisable to climb a grade with wide open throttle in order that the time on the grade be kept as short as possible.

After the helper locomotive has been coupled on, the air brake equipment is set for double heading as in past practice. The Rotair valve on the second locomotive should be left in "PASS" to give engineman the use of independent brake valve. It is not necessary to cut out the electro-pneumatic brake. Both a standing and running brake test should be made from leading locomotive.

After starting, it is generally good practice to get the Diesel locomotive into parallel as soon as practicable. The throttle may then be reduced to maintain desired speed.

If the grade is such that locomotive speed gets below minimum continuous speed, the throttle must be reduced to put more of the load on the helper locomotive.

308 **Operating With Diesel Locomotive As Helper** The operation of the E8 locomotive in passenger service in mountainous country with a Diesel locomotive as a helper is basically the same as that for a steam locomotive helper.

A Diesel locomotive that is used in helper service is generally geared for much lower top speed than that of a passenger Diesel. Care must be exercised so the train speed does not exceed that of the locomotive geared for the lowest speed.

PROBLEMS DURING OPERATION

309 **If Alarm Bells Ring** An alarm signal light will be lighted in the unit affected:

RED — Engine water temperature over 208° at outlet (approximately 200° on gauge). Check water level, shutters and fans. If condition cannot be corrected at once, isolate engine and investigate for cause. If the fuel pump motor circuit breaker in the engine control panel is off, the fuel pump will stop and cooling system fan and shutter control will be inoperative. The air supply shut-off valves for the shutters are mounted on the engineroom wall on left side of locomotive, on each side of side doors, about opposite the engine governors.

YELLOW & BLUE — Low lube oil pressure or high lube oil suction. Engine will be stopped. Isolate engine and reset governor trip button to stop alarm bells. Check oil level and condition. If no difficulty is evident start engine, check oil pressure. Place engine on line. Watch oil pressure and suction gauge.

Under extremely high cooling water temperatures, an otherwise normal engine may have oil pressure fall low enough to trip alarm.

BLUE — No power (whenever engine stops while "on the line" this light will light, since stopping engine, of course, stops the alternator). Check overspeed trip and fuel flow, start engine and attempt to put engine "on the line." If light comes on instantly, or if light lights with engine running, check auxiliary generator field circuit breaker and alternator field circuit breaker. If light does not come on, after engine is started, but engine will not respond to throttle, check ground relay. See Art. 319.

GREEN — Steam generator failure. See Section 6.

NOTE: The yellow lube oil alarm light will burn whenever the governor low oil alarm switch is tripped whether isolation switch is in "start" or "run" position. The "NP" light is energized through the fuel pump control circuit so that if the "PC" switch is tripped or the fuel pump circuit breaker in the cab is in "Off" position, this alarm will not operate.

310 **If Locomotive Fails (All Units) To Produce Power With Engines Running** If engines are stopped, start engine. See Art. 300.

1. Check "control," "generator field," and "fuel pump" circuit breakers and position of reverse lever.
2. Check "PC" switch (tell tale pin should be down or indicating light not burning).

3. Check control fuses. Move throttle to "STOP" position, if engines begin to die, quickly return throttle to "idle." If engines do not slow down check 60-ampere control fuse in the electrical control cabinet.
4. Check brakes.
5. If trouble still persists, check each unit.

NOTE: If locomotive is putting out power, output of "A" unit can be read directly from load indicating meter. Throttle response can be told by sound of engine. Both are important observations.

311 **If Any Unit Fails To Produce Power With Engine Running** If engine is stopped, check overspeed trip lever, and fuel flow, and low oil pressure trip on governor, then start engine or see Art. 300.

1. Refer to Fig. 2-1, Section 2, and check each item under "Unit Failure Check" for proper setting and reading in electrical control cabinet.
2. Check battery field fuse.
3. Check control jumpers between units, they may be loose or contacts dirty or burned.
4. A careful check of these items will reveal the more common difficulties (75% of the troubles). An unusual difficulty requires careful study of the particular situation.

Any piece of mechanical equipment is subject to some difficulties. An arrangement of protective devices is provided on these locomotives to prevent damage in case of a failure or careless operation. OVERLOADING IS ONE EXCEPTION AND IS ENTIRELY THE RESPONSIBILITY OF THE ENGINEMAN. As soon as it is apparent that the tonnage is too great, the engineman must take the proper steps to reduce train tonnage.

In cases of serious difficulty in a unit the engine should be immediately isolated and an investigation made.

312 **Isolating And Stopping An Engine While Under Power Or Using Dynamic Braking**

(For normal stopping procedure, see Art. 301).

If it becomes necessary to take an engine "off the line" while the locomotive is operating under power, it should be done as follows:

1. Pull manual control lever shut. Hold until engine stops.
2. When bell starts ringing place the isolation switch in the "start" position.
3. Place fuel pump switch in "OFF" position.

313 **Starting And Placing Engine On The Line While Locomotive Is Under Power**

1. Start engine in the usual way. (See Art. 300).
2. After lubricating oil pressure builds up, place isolation switch in "run" position. If throttle is above third position, hold off on governor to injector linkage with layshaft manual control lever, to allow engine to come up to speed gradually. DO NOT place an engine "on the line" when using dynamic brake. See Art. 323.

SPECIFIC DIFFICULTIES

314 **Recovery Of Control Of Brake After Penalty Application**

1. Place automatic brake valve in "LAP."

2. Close throttle to idle.
3. Place foot on safety control foot pedal.
*4. Wait until application pipe builds up to main reservoir pressure. (Listen for exhaust or watch PC switch light - if used).
5. Reset train control.
6. Check PC switch.
7. Release brakes.

* If "PC" will not reset with automatic brake valve handle in "LAP," after an emergency application, place brake valve handle in running position.

315 **Setting "PC" Switch** Recover brake, see Art. 314. If "PC" switch is tripped, locomotive will have power in No. 1 throttle position (shown on load indicating meter) but engine speed will not advance as throttle is opened. Fuel pumps will be stopped. In No. 5 or No. 6 throttle position the engines will stop. No bells will ring. The fuel pump circuit breaker in the cab open or the fuel pump circuit breaker open on the engine control and instrument panel in engineroom will have the same effect as a tripped "PC" switch.

316 **Auxiliary Generator Charging Rate** Failure of auxiliary generator will stop excitation of alternator and cause a blue light. Auxiliary generator ammeter can show 20-30 amperes charge and still have 175-ampere circuit breaker "OFF." In case of auxiliary generator failure, stop engine affected and check 30 ampere auxiliary generator circuit breaker and 175 ampere circuit breaker.

317 **Starting Contactors** Main contact points must not stick closed. The interlock located underneath main contactor must be closed and making good contact. If interlocks do not close or make good contact, engine will speed up when throttle is opened but will not load.

Above No. 5 throttle position the fuel indicator on the governor will be unbalanced to minimum fuel (low power piston) and load regulator will point toward 5 o'clock.

318 **Control Air** Control air should be 80 $\pm$ 3 lbs. to supply air to close main contactors. Failure of control air will stop power output as main contactors will not close. Engines will speed up in response to throttle. Above No. 5 throttle position, the fuel indicator will be unbalanced to minimum fuel (low power piston) and load regulator will point toward 5 o'clock. See Art. 324.

319 **Ground Relay** Pointer points to yellow dot when set, red dot when relay is tripped. When the ground relay is tripped the engine will not speed up when throttle is opened. In No. 5 or 6 throttle position engine will stop and blue light will light. To reset, isolate engine, reset relay, and put engine on line. If relay continues to trip, isolate engine affected.

320 **Wheel Slip Relay** The wheel slip relay is located in the electrical control cabinet, behind the power contactors. If one pair of wheels should slip while locomotive is under power, this relay will pick up, lighting the wheel slip light intermittently to warn engineman as the wheels slip, stop slipping and slip again. The throttle should be reduced to stop slipping, and sand applied to prevent slipping when throttle is reopened.

321 **Alarm Indications For One Pair Of Wheels Sliding** If one pair of wheels should slide when starting a train, the wheel slip light will flash on and off intermittently, but as the train speed increases, the light will stay on more or less continuously, and will not go out when the throttle is reduced and sand applied. The light will go out when throttle is closed to idle.

Under this condition, the engine crew should make an immediate investigation to determine the cause. The wheels may be sliding due to a locked brake, a broken

gear tooth wedged between the pinion and ring gear, or a motor bearing may have seized.

Repeated ground relay action, accompanied with unusual noises such as continuous thumping or squealing, or the smell of burning paint or insulation, may be an indication of very serious traction motor trouble that should be investigated at once.

UNDER NO CONDITION OF REPEATED WHEEL SLIP INDICATION OR REPEATED GROUND RELAY ACTION SHOULD A LOCOMOTIVE UNIT OR POWER PLANT BE ISOLATED AND CONTINUED IN SERVICE WITHOUT FIRST MAKING THE ABOVE INVESTIGATION.

322 **Engine Speed and Fuel Indicators** (On Governor) There are two pointers on the cover of the governor. One of these pointers indicates the throttle position of the engine and is labeled "speed." The second pointer indicates the position of the power piston in 16ths of an inch and is labeled "fuel." The lower the number on the "fuel scale" the greater the quantity of fuel which is being injected into the cylinders. In No. 8 throttle "speed" position the fuel indicator needle should read between 5 and 6 if the engine is properly loaded. In general, the two pointers should be checked only in No. 8 throttle position as indications at part throttle may be misleading. If a marked variation is noted the trouble should be investigated. Excessive fuel (lower number on fuel scale) will indicate engine trouble. Minimum fuel will indicate electrical trouble.

323 **Isolation Switch** Isolation switch must be firmly in "run" (vertical) position to obtain power from the unit. The switch should be opened and closed only with engine at idle speed or stopped.

324 **Load Regulator** When operating with throttle in Run 8, load regulators throughout the locomotive should be in approximately the same position. Extreme unbalance of the load regulator arm in one power plant

to maximum or minimum field is an indication of difficulty and should be investigated. If in minimum field (arm in 5 o'clock position), trouble may be either mechanical or electrical. If in maximum field (arm in 8 o'clock position), inspect for loss of electrical load.

325 **Fuel Flow** For proper engine operation a good flow of fuel (clear and free of bubbles) should be indicated in the FUEL RETURN sight glass located on the duplex filter assembly nearest the engine. Normally, a small amount of fuel will leak by the plunger, and come out the small hole in the standpipe of the BY-PASS sight glass. If leakage is enough so fuel flows out top of the standpipe, it indicates clogged sintered bronze filters. If great enough to stop flow of fuel through FUEL RETURN sight glass, engine may lose power — report to maintenance forces. Check fuel pump motors and fuel pumps. If pumps in all units are stopped, check "PC" switch, fuel pump circuit breaker at engineman's control panel and 60-ampere control fuse in electrical control cabinet in lead unit. If one fuel pump has stopped and the rest of the pumps are running, check circuit breaker on engine control panel of power plant affected. Check flexible electrical connection to fuel pump motor. If both pumps in any one particular unit only are stopped, check 60-ampere control fuse in electrical control cabinet of unit affected.

If pump is running but no fuel is pumped, check fuel supply, emergency fuel cutoff, Fig. 5-8; or check for a suction leak in piping between tank and pump, also check for broken or slipping coupling at fuel pump.

326 **Overspeed Trip** When tripped, fuel is stopped at the injectors and engine can not be started. Whenever an engine is found stopped, always check overspeed trip by pulling firmly on the lever (counter-clockwise) to be sure it is set. See Fig. 5-9.

327 **Battery Field Fuse** There is a 60-ampere fuse in the battery field circuit of each main generator. Should this fuse be blown no power will be developed in the power plant affected. The battery field fuse is located in the electrical control cabinet and is accessible through a door in the rear wall of the operating cab and in No. 2 electrical control cabinet.

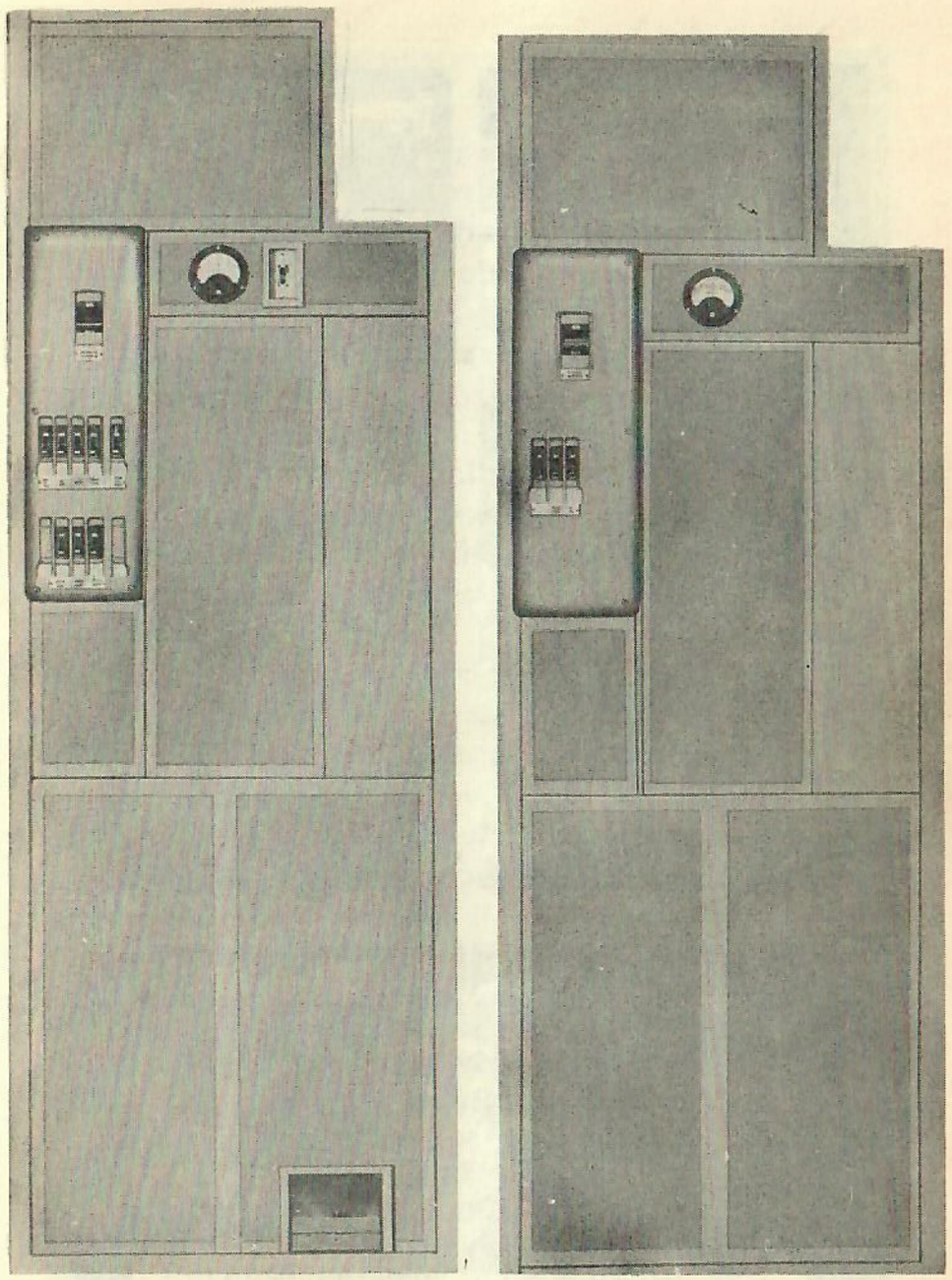
328 **Running Through Water** Under ABSOLUTELY no circumstances should the locomotive pass through water which is deep enough to touch the bottom of the traction motor frames. When passing through water, always go at a very low speed (2 to 3 miles per hour). Water any deeper than three inches above top of rails is likely to cause damage to the traction motors.

329 **Operation Of E8 Locomotives With Older "E" Type Locomotives**

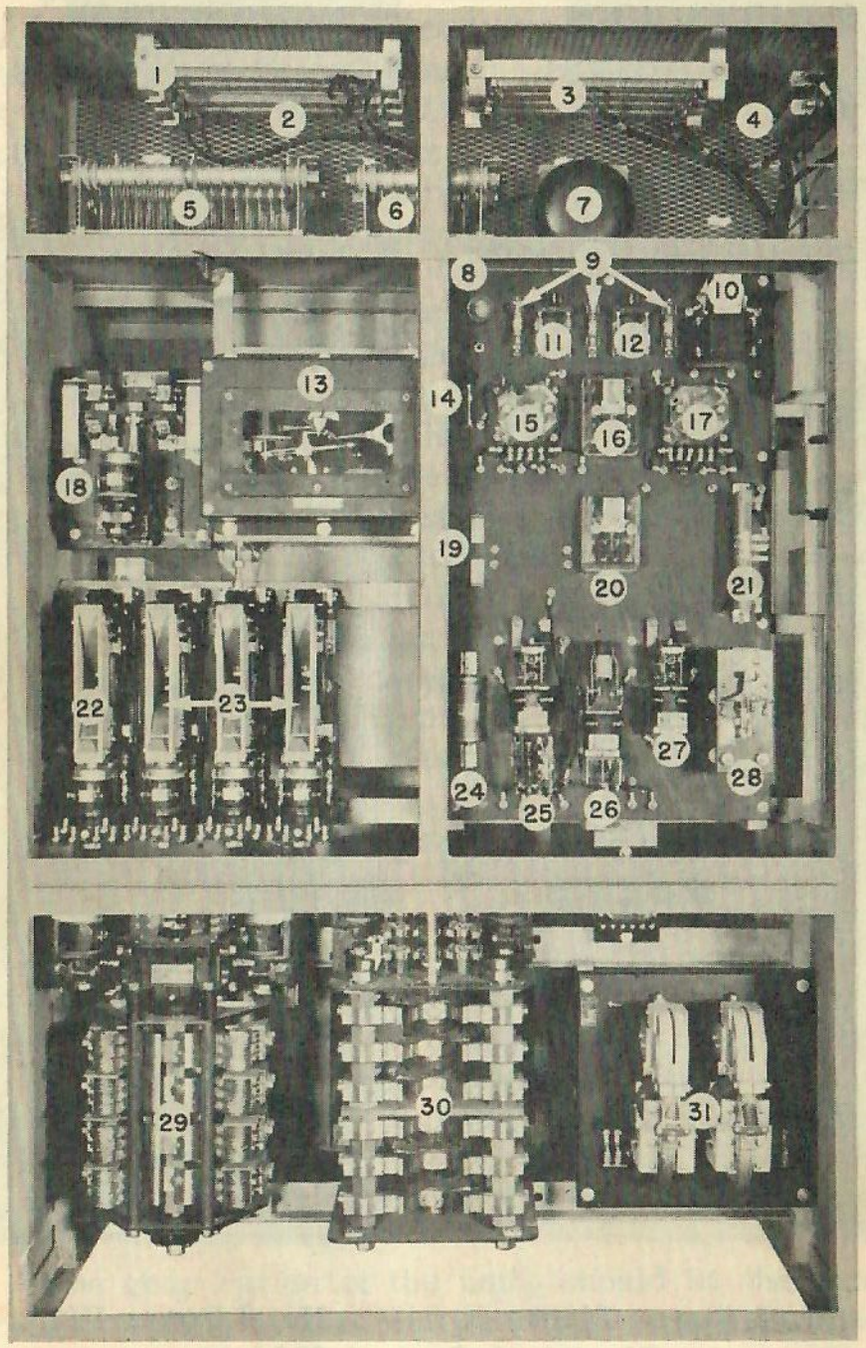
A special control jumper is needed for the operation of E8 locomotives when combined with older "E" type locomotives, one end of which has 16 points, while the other end has 27 points.

E8 locomotives have a continuous operation of 750 amperes while older "E" type locomotives are held at 625 amperes. If the E8 is leading, with older "E" type locomotives in the consist, do not exceed 625 amperes for continuous operation, to prevent damage to the motors under the older locomotives, also, do not go below the minimum continuous speed of the older "E" type locomotives.

The gear ratios of the units should be the same. Locomotive units of different gear ratios may be operated together ONLY if a study is first made by Elec-tro-Motive, and special instructions issued.

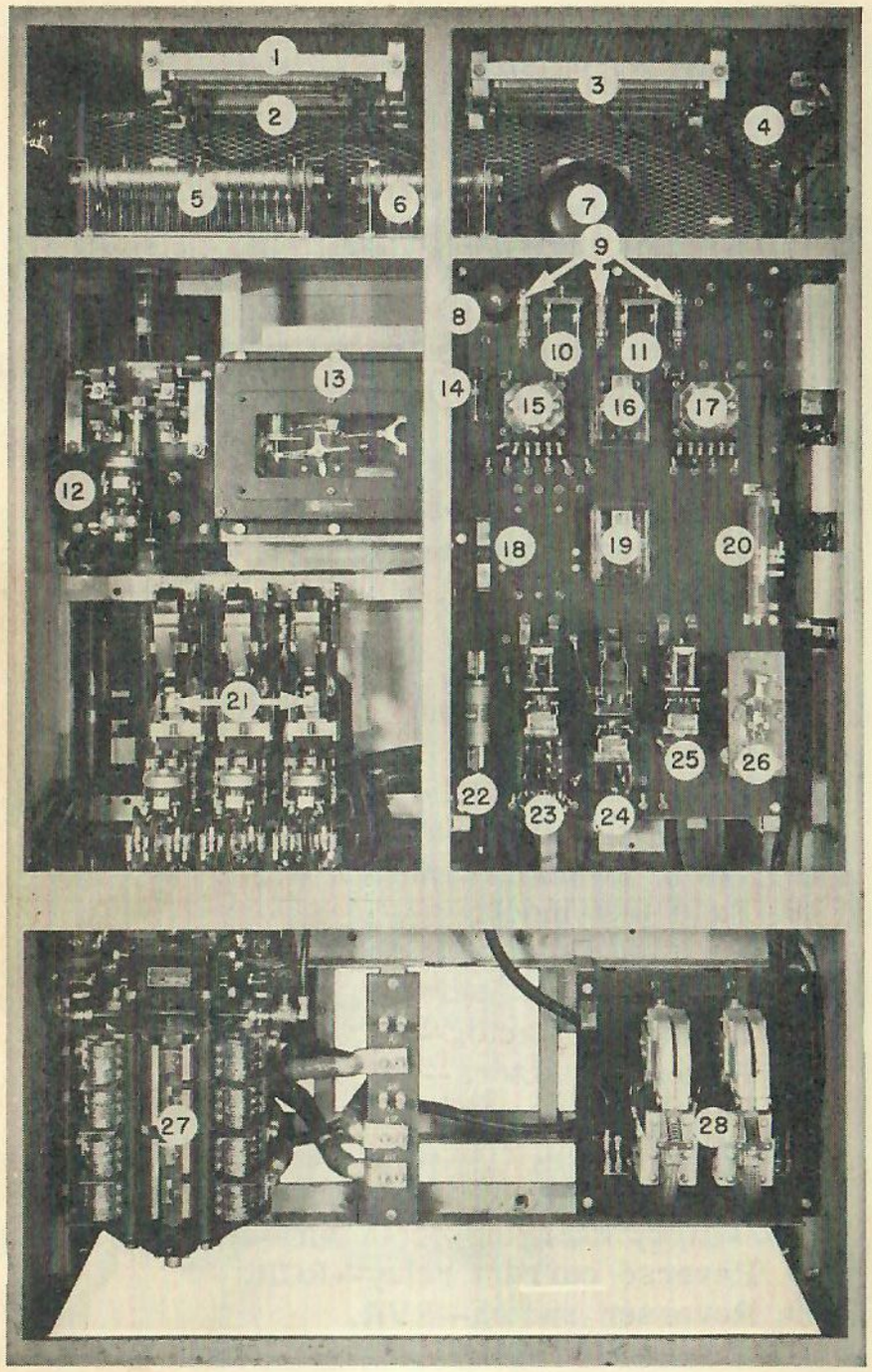


No. 1 Power Plant No. 2 Power Plant
Electrical Control Cabinets
Fig. 3-2



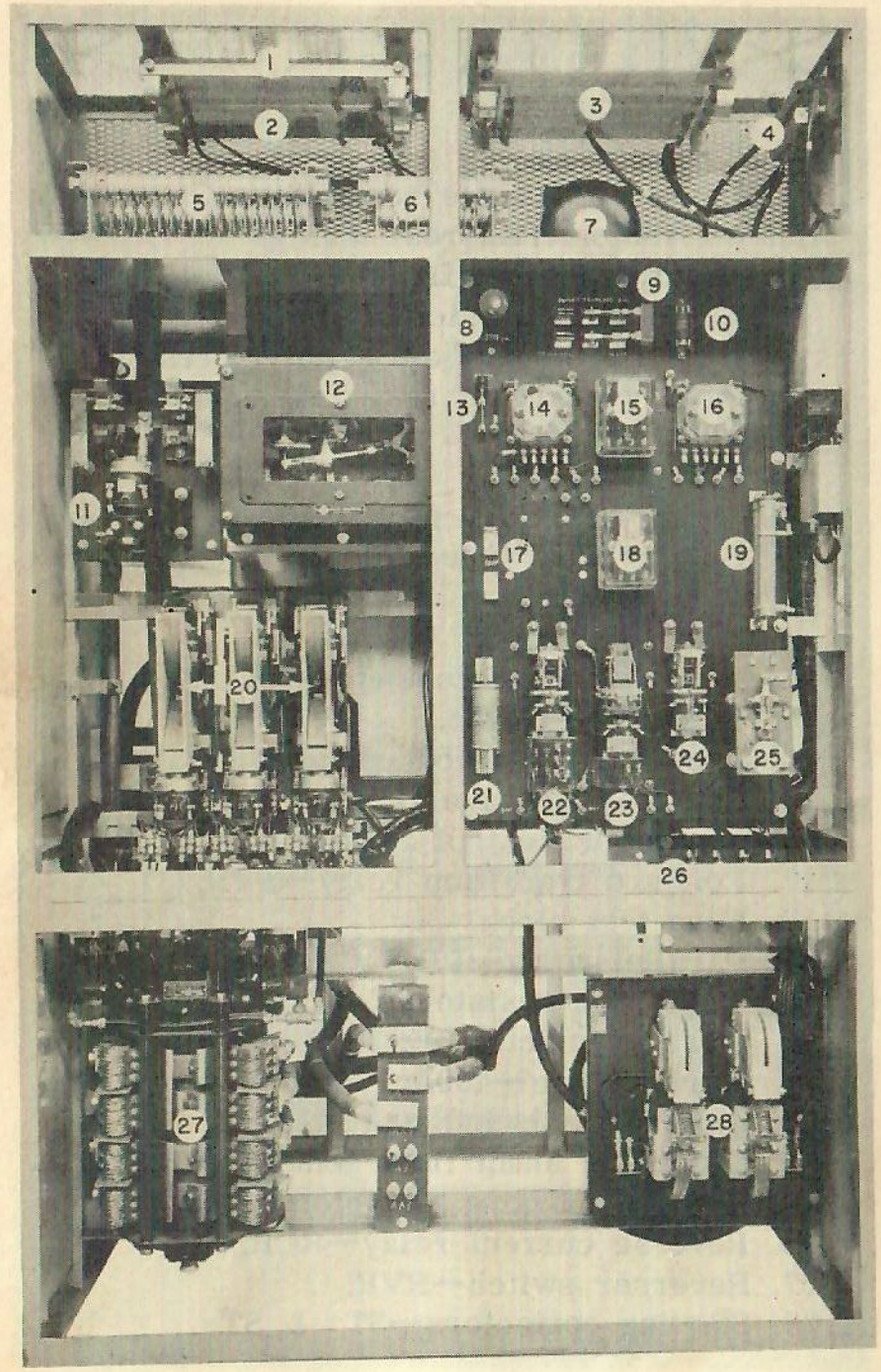
Electrical Control Cabinet — No. 1 Power Plant
With Dynamic Braking
Fig. 3-3

1. Battery discharge resistor.
2. Alternator field resistor.
3. Generator shunt field resistor.
4. Wheel slip resistor.
5. Traction motor field shunting resistor.
6. Battery charging resistor.
7. Alarm bell.
8. Fuse test light.
9. Lights and control fuses—60A.
   Battery field fuse—70A.
10. Field loop contactor—FL.
11. Light switch.
12. Control switch.
13. Voltage regulator.
14. Ground relay cutout switch.
15. Ground protective relay—GR.
16. Pneumatic control relay—PCR.
17. Forward transition relay—FTR.
18. Motor shunting contactor—M.
19. Fuse test block.
20. Parallel relay—PR.
21. Transition resistors.
22. Braking contactor—B1.
23. Power contactors—P2, S12, P1.
24. Starting fuse—400A.
25. Battery field contactor—BF.
26. Generator shunt field contactor.
27. Battery charging contactor—BC.
28. Reverse current relay—RCR.
29. Reverser switch—RVR.
30. Cam-switch.
31. Starting contactors—ST + & ST -.



Electrical Control Cabinet — No. 1 Power Plant
Without Dynamic Braking
Fig. 3-4

1. Battery discharge resistor.
2. Alternator field resistor.
3. Generator shunt field resistor.
4. Wheel slip resistor.
5. Traction motor field shunting resistor.
6. Battery charging resistor.
7. Alarm bell.
8. Fuse test light.
9. Lights & control fuses—60A.
   Battery field fuse—70A.
10. Light switch.
11. Control switch.
12. Motor shunting contactor—M.
13. Voltage regulator.
14. Ground relay cutout switch.
15. Ground protective relay—GR.
16. Pneumatic control relay—PCR.
17. Forward transition relay—FTR.
18. Fuse test block.
19. Parallel relay—PR.
20. Transition resistors.
21. Power contactors—P2, S12, P1.
22. Starting fuse—400A.
23. Battery field contactor—BF.
24. Generator shunt field contactor—SH.
25. Battery charging contactor—BC.
26. Reverse current relay—RCR.
27. Reverser switch—RVR.
28. Starting contactors—ST+ & ST-.



Electrical Control Cabinet — No. 2 Power Plant
Without Dynamic Brakes
Fig. 3-5

1. Battery discharge resistor.
2. Alternator field resistor.
3. Generator shunt field resistor.
4. Wheel slip resistor.
5. Traction motor field shunting resistor.
6. Battery charging resistor.
7. Alarm bell.
8. Fuse test light.
9. Steam generator transfer switch.
10. Battery field fuse—70A.
11. Motor shunting contactor—M.
12. Voltage regulator.
13. Ground relay cutout switch.
14. Ground protective relay—GR.
15. Signal relay—SR.
16. Forward transition relay—FTR.
17. Fuse test block.
18. Parallel relay—PR.
19. Transition resistors.
20. Power contactors—P3, S23, P4.
21. Starting fuse—400A.
22. Battery field contactor—BF.
23. Generator shunt field contactor—SH.
24. Battery charging contactor—BC.
25. Reverse current relay—RCR.
26. Steam generator fuses.
27. Reverser switch—RVR.
28. Starting contactors—ST + & ST -.

NOTES

SECTION 4

ENGINE COOLING, LUBRICATING OIL, FUEL OIL AND ENGINE ROOM VENTILATING SYSTEMS

COOLING SYSTEM

Water is circulated through the engine radiators and around the oil coolers by two pumps mounted on the engine. Cooling air through the radiator is controlled by shutters and three electrically driven cooling fans. The operation of the fans and shutters is entirely automatic and under normal conditions will hold the temperature of the engine cooling water so that the gauge on the inlet of left water pump will read in the green area (120° - 190°).

In the event of excessive cooling water temperature the high temperature alarm switch will close, causing a red light to show on the engine affected and the alarm bells to ring in all units.

400 Operating Water Level Operating water levels are stenciled on the water tank next to the water gauge glasses to indicate minimum and maximum water levels with engine running and stopped. The engine should never be operated with the water below the low water level. Progressive lowering of the water in the gauge glasses indicates a leak in the cooling system and should be reported.

The system is filled either through the filler pipe located on the roof of the locomotive, or through the filler pipe at the center of the unit on either side.

To fill the system proceed as follows:

1. Stop engine.
2. Open filling level valve "G."

3. Fill slowly until water runs out filling level pipe at valve "G."
4. Close filling level valve "G."

If filling a dry or nearly dry engine also follow these additional steps:

5. After the preliminary filling, start engine and run several minutes. This will eliminate any air pockets in the system.
6. Shut down engine and open valve "G," and wait 3 minutes.
7. Add water until it runs out filling level pipe.
8. Close filling level valve "G."

If the cooling system of a hot engine has been drained, do not refill immediately with cold water. If this is done, the sudden change in temperature might crack or warp the cylinder liners and heads.

CAUTION:
1. Do not attempt to fill the cooling system through the drain pipe located underneath the locomotive.
2. The system should not be filled above the maximum water level indicated on the water tank.
   a. To prevent freezing of radiators in winter.
   b. To prevent loss of rust inhibitor when draining back to "G" valve level.

LUBRICATING OIL SYSTEM

Oil under pressure is forced through the engine for lubrication and piston cooling by the duplex piston cooling and lube oil pump. Lube oil which falls into

the oil pan is picked up by the scavenging oil pump and forced through the oil cooler and filters to the oil strainer housing where it is ready for recirculation by the oil pump. The excess returns to the oil pan where it is held until used.

401 **Oil Level** The oil level may be checked with the engine running at any speed and should read between "low" and "full" on either bayonet gauge (one on each side of engine). When the engine is stopped the oil from the filter and cooler will drain back into the oil pan and the level on the dipstick should show "system charged." The mark "system uncharged" is used by maintenance forces when filling oil pan when new oil filter elements are installed.

402 **Adding Oil To System** When oil is added to the system, it must be poured through the opening having the square cap on top of the strainer housing. Should the round caps be removed while the engine is running, hot oil under pressure will come from the openings and possibly cause personal injury.

When the engine is stopped, all the oil in the cooler core will drain into the Michiana filter and the strainer chamber and then overflow into the engine oil pan, which will bring the engine oil pan bayonet gauge reading to "system charged." This level is below the "system uncharged" level because some oil is trapped in the lube oil filter, oil lines and engine.

403 **Oil Pressure** Oil pressure at 800 RPM is normally 35 to 45 pounds. It should not drop below 20 pounds. At idle the pressure should be at least 6 pounds. (In the event of dangerously low oil pressure the engines will automatically be stopped).

FUEL OIL SYSTEM

Fuel in each unit is circulated through the injectors by an electric driven fuel pump. Failure of pump to operate, closed emergency fuel cutoff valve, or clogged strainer can cause fuel failure - See Section 5 of this manual.

404 **Fuel and Water Tank** The fuel and water tank on the E8 locomotive is a combination tank, holding 1350 gallons of water and 1200 gallons of fuel. A single sheet of rolled steel separates the fuel from the water. The edges of this sheet extend beyond the water tank where they are welded together, with all welds on the outside, thus reducing the possibility of leaks to a minimum.

As the water compartment of the tank surrounds the fuel compartment, the fuel tank is protected against punctures from flying objects reducing a possible fire hazard, and as the water in the tank is warmer than outdoor temperature (during extreme cold weather), the fuel is warmed when it reaches the fuel pump strainers, which reduces the possibility of clogged filters due to paraffin precipitate.

405 **Fuel And Water Gauges** These direct reading air operated gauges are located on the engine-room wall on the right side of the locomotive. The gauges are calibrated in inches. The conversion table, Fig. 4-1, shows gallons per inch of depth in both fuel and water tanks. The gauges do not show fuel and water levels continuously; a push-button needle valve directly below each gauge must be pushed in to get indication on the gauge.

406 **Filling Fuel Tank** The fuel tank can be filled from either side of the locomotive at a maximum rate of 250 gallons per minute due to baffles and vents in the tank. Direct reading sight level gauges located

WATER		FUEL	
Inches	Gallons	Inches	Gallons
1	4	1	6
2	47	2	10
3	95	3	15
4	152	4	20
5	221	5	27
6	295	6	41
7	375	7	65
8	461	8	94
9	543	9	125
10	615	10	160
11	677	11	202
12	737	12	248
13	793	13	300
14	845	14	358
15	894	15	421
16	940	16	485
17	985	17	548
18	1027	18	605
19	1065	19	660
20	1100	20	722
21	1132	21	785
22	1161	22	855
23	1190	23	940
24	1218	24	1022
25	1245	25	1092
26	1268	26	1165
27	1290	26 1/2	1200
28	1308		
29	1325		
30	1339		
31	1350		

Fuel And Water Tank Conversion Table
Fig. 4-1

on each side of the fuel tank adjoining the fuel fillers indicate level of fuel oil starting at 4-1/2" from the top of the tank and should be observed while filling the tank to prevent overflowing. The fuel should be filtered through a reliable fuel filter before it enters the tank. The fuel capacity of each tank is 1200 gallons. DO NOT HANDLE FUEL OIL NEAR AN OPEN FLAME.

407 **Emergency Fuel Cut-Off Valve** An "Emergency Fuel Cutoff Valve" is provided to cut off the fuel supply to the fuel pump in the event of fire, or any emergency. It is located in the center of the tank, and is accessible through a plate on the bottom of the tank.

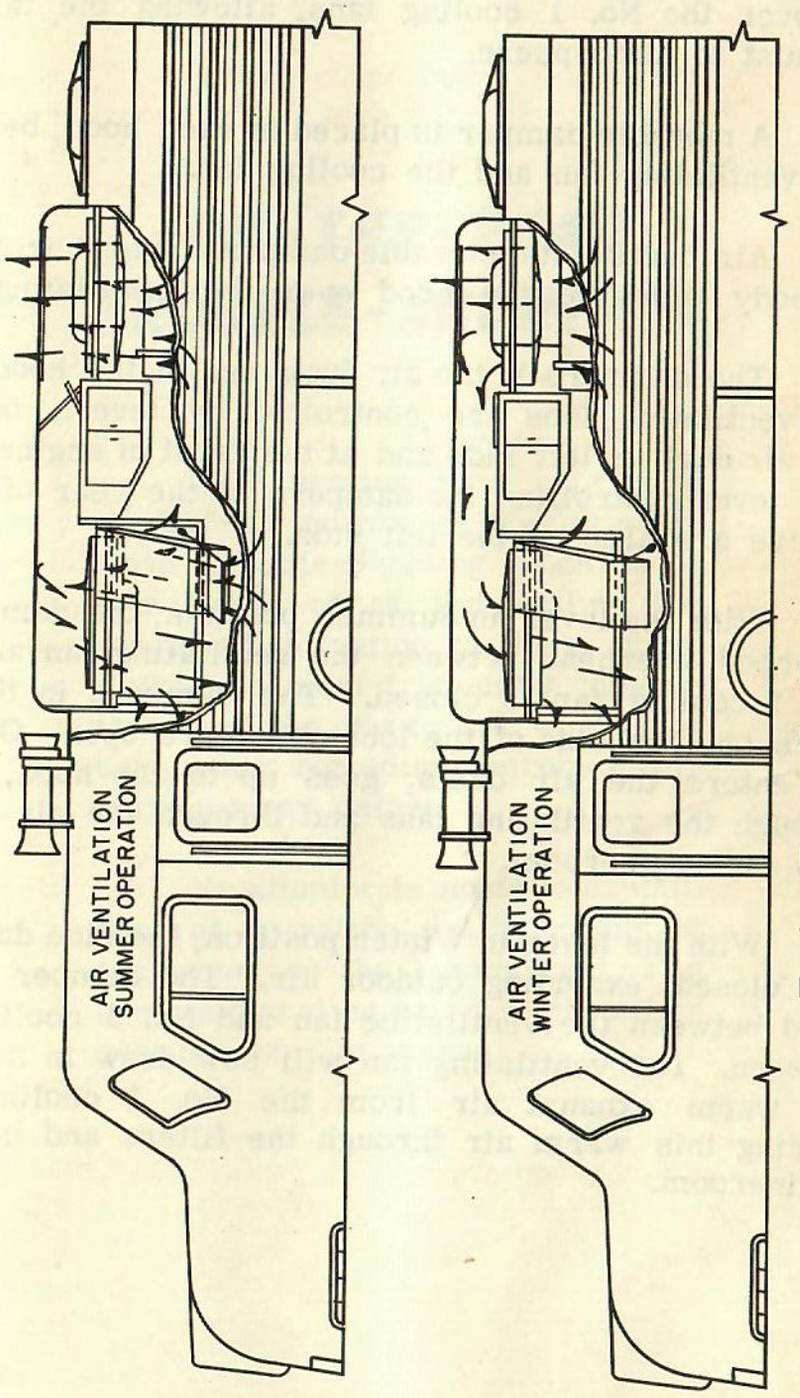
The trip and reset lever is accessible through a hole in the engineroom floor, in the cross aisle between the two engines. On each side of the locomotive, attached to the side skirt, is a small box with a lift cover. Enclosed in this box is a pull ring on the end of the cable running to the fuel cutoff valve. A similar ring is located in the operating cab of each "A" unit.

The fuel cutoff valve can be tripped, and the fuel cut off by pulling any one of these rings, or by pulling up on reset lever. If tripped, the valve may be reset by pushing down on the reset lever.

ENGINE ROOM VENTILATING SYSTEM

408 **Ventilating System** Two ventilating fans in the roof of the locomotive (one on each power plant) supply air to the engineroom for engine scavenging, air compressors and main generator and traction motor cooling, Figs. 4-2.

Air hoods are built onto the locomotive roof covering the ventilating fans, and extending over the No. 1



Engine Room Ventilating System
Fig. 4-2

engine cooling fans on each power plant. An open grill is over the No. 1 cooling fans, allowing the fans to exhaust to atmosphere.

A movable damper is placed in each hood, between the ventilating fan and the cooling fan.

Air ducts with movable dampers extend from the carbody sides to the hood over the ventilating fan.

The dampers in the air ducts and in the hood over the ventilating fans are controlled by levers, one on the air duct on left side and at the front of engineroom. The lever controlling the dampers at the rear of locomotive are also on the left side.

With the lever in Summer position, the damper in the hood overhead between the ventilating fan and the No. 1 cooling fan is closed. The dampers in the air ducts on each side of the locomotive are open. Outdoor air enters the air ducts, goes up to the hood, down through the ventilating fans and through the air filters into the engineroom.

With the lever in Winter position, the side dampers are closed, excluding outdoor air. The damper in the hood between the ventilating fan and No. 1 cooling fan is open. The ventilating fan will now draw in some of the warm exhaust air from the No. 1 cooling fan, forcing this warm air through the filters and into the engineroom.

SECTION 5

ON-THE-ROAD TROUBLE-SHOOTING

This section is a reprint of the TS3-E8 edition of the "On-the-Road Trouble-Shooting" booklet. It provides a check list calling the operator's attention to the troubles which are most frequently encountered on the road, and which can be quickly remedied thereby eliminating many delays.

No attempt is made to explain general operation and functions of equipment on the locomotive. For such information refer to the other sections of this manual.

1. WHAT IS NECESSARY TO MAKE THE LOCOMOTIVE OPERATE?

The following 13 items are essential: Items (a) to (d) in the cab from which you are operating and items (e) to (m) in all units of the locomotive.

a. "PCS. OPEN" light must NOT be burning.
(If light is burning see Page 505, Question 2.)

b. The control, fuel pump, and generator field switches must be in the "ON" position.

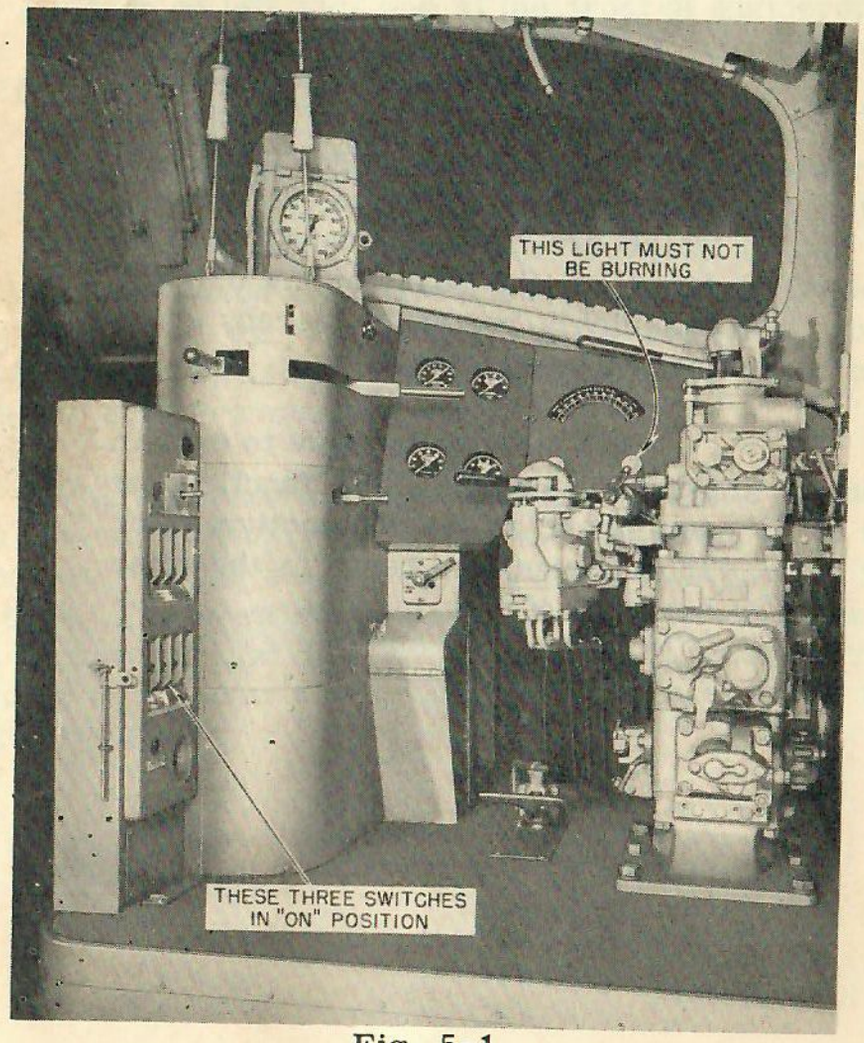


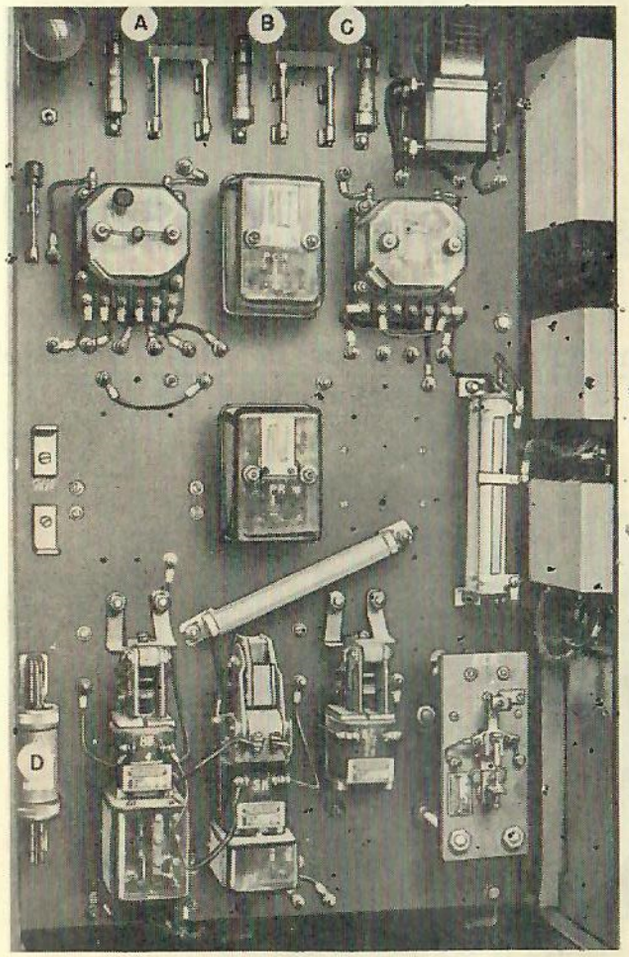
Fig. 5-1

c. The engineman's reverse lever must be in the forward or reverse position and transition lever in power position.

d. All the brakes must be released.

e. All switches in each electrical cabinet must be closed. All fuses should be good.

f. There must be approximately 80 pounds of control air pressure on the gauge mounted on outside wall of each electrical control cabinet, in engineroom. (If no pressure or incorrect pressure, see Page 510, Question 10.)



A. Light Fuse
B. Control Fuse
C. Battery Field Fuse
D. Starting Fuse

Fig. 5-2

g. Fuel pumps in all units must be running and fuel flowing through sight glasses.
(If not refer to Pages 506 & 507, Questions 5 &6.)

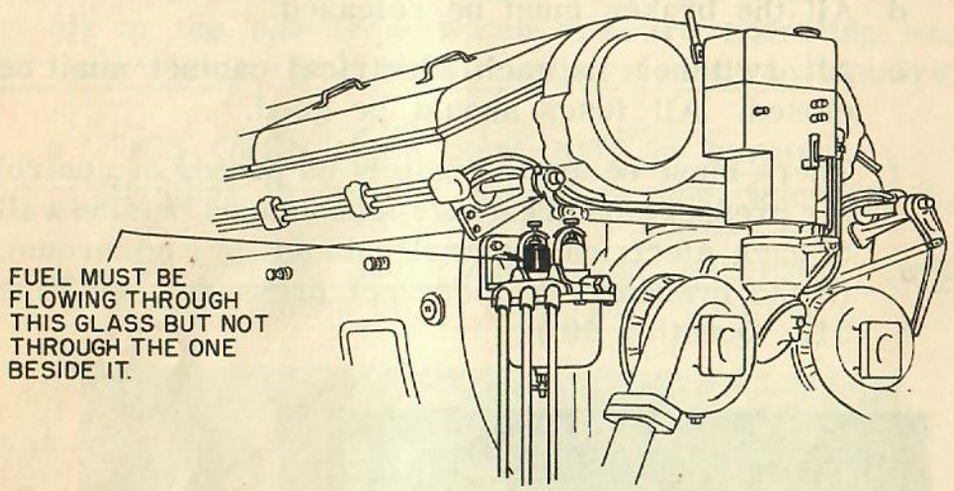


Fig. 5-3

h. The engines must be running.
(If stopped refer to Page 508, Question 7.)

i. The isolation switches must be in "RUN" position.

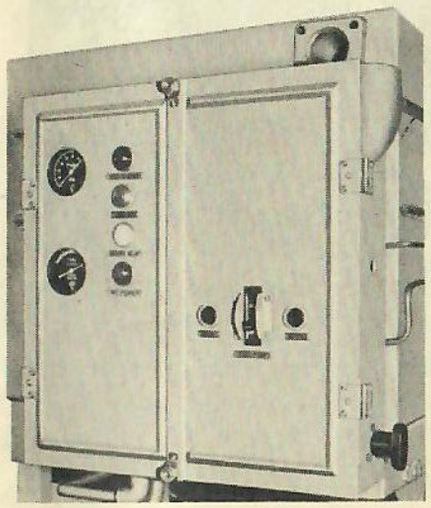


Fig. 5-4

j. The ground protective relays must be set.

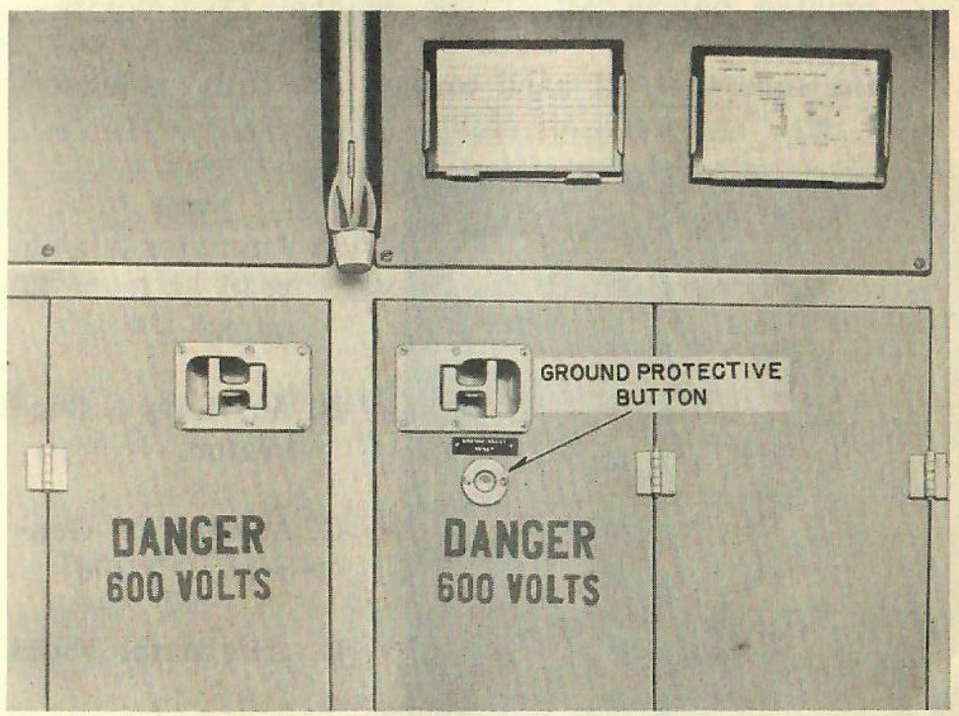


Fig. 5-5

k. The starting contactors must NOT be stuck closed.

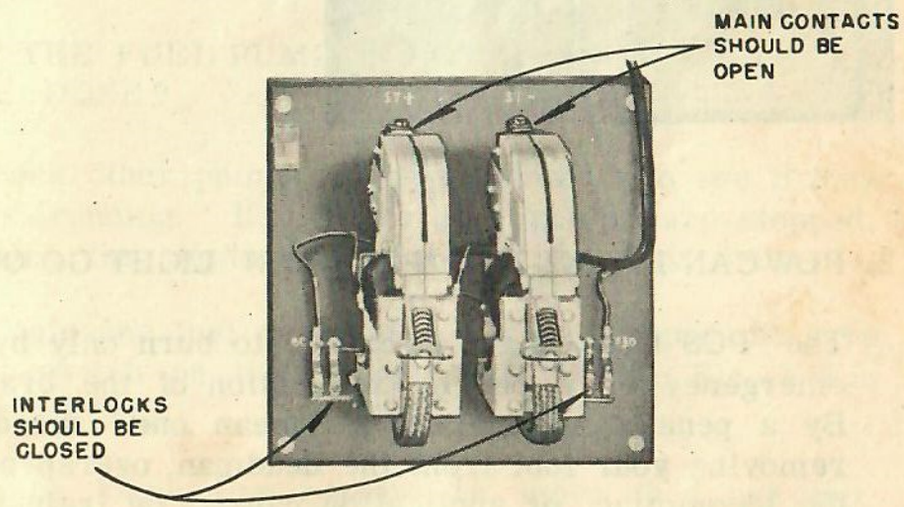
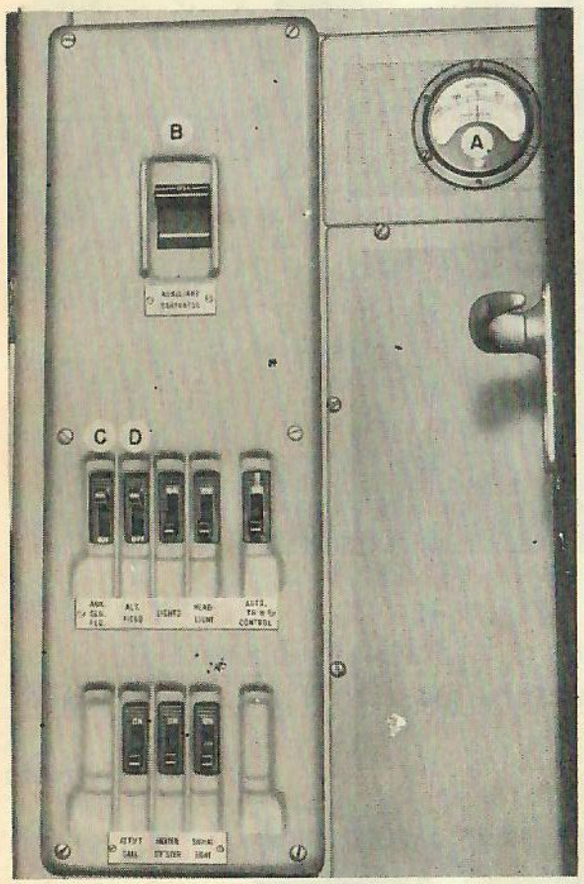


Fig. 5-6

l. All circuit breakers in electrical cabinet should be in the "ON" position. Circuit breakers designated below "MUST" be in the "ON" position.

m. Be sure that all hand brakes are fully released.



A. Ammeter (should read at least 20 amps)

B. Auxiliary Generator.

C. Auxiliary Generator Field

D. Alternator Field

Fig. 5-7

2. HOW CAN I MAKE THE "PCS OPEN" LIGHT GO OUT?

The "PCS Open" light is caused to burn only by an emergency or a penalty application of the brakes. By a penalty application, we mean one caused by removing your foot from the deadman, overspeeding the locomotive, or application caused by train control devices.

To get the light to go out a good procedure is to be sure the throttle is in "idle" position and then take whatever steps are necessary to fully release the automatic brake.

If the brakes are applied in "Service" the brake valve may be placed in lap and left there until the light goes out. If there has been an emergency application, the brake valve must be lapped and then moved to running position before the light will go out.

3. IF I DO NOT GET THE "PCS OPEN" LIGHT TO GO OUT WHAT WILL HAPPEN?

Engines will idle for about five minutes, but after that the engines may stop for lack of fuel since when the "PCS Open" light is burning all the fuel pumps in the locomotive are stopped.

4. IF AN ENGINE STOPS WHEN THE "PCS OPEN" LIGHT IS BURNING WILL THE BLUE LIGHT COME ON AND THE ALARM BELLS RING?

No.

5. IF THE FUEL PUMP IS NOT RUNNING WHAT CAN BE DONE?

Check other pumps in the locomotive to see if they are running. If all the fuel pumps are stopped, check the items shown on Figs. 5-1 & 5-2.

If only one fuel pump in a unit is stopped, be sure the switch on the engine control panel, Fig. 5-4 is turned on.

If the locomotive consist is more than one unit,

and both fuel pumps in the same unit are stopped, be sure the switches on the engine control panels are "ON" and the control fuse is good in that unit. (Figs. 5-2 and 5-4.)

6. IF THE FUEL PUMP IS RUNNING BUT FUEL DOES NOT SHOW IN THE FUEL RETURN SIGHT GLASS (Fig. 5-3) WHAT CAN BE DONE?

If fuel is flowing in the other glass (60 pound) next to the return sight glass, the fuel filters are clogged and nothing can be done on the road.

If fuel is not flowing in the sight glasses of the No. 1 and No. 2 engines in the same unit, check to see that the emergency fuel cutoff valve has not been tripped (Fig. 5-8). This valve is located under the floor between the engines, and is reached through a trap door in the carbody floor. If this valve is properly set, the suction strainers may be clogged. In an emergency the filtering material may be removed and the filter elements replaced without the filtering material.

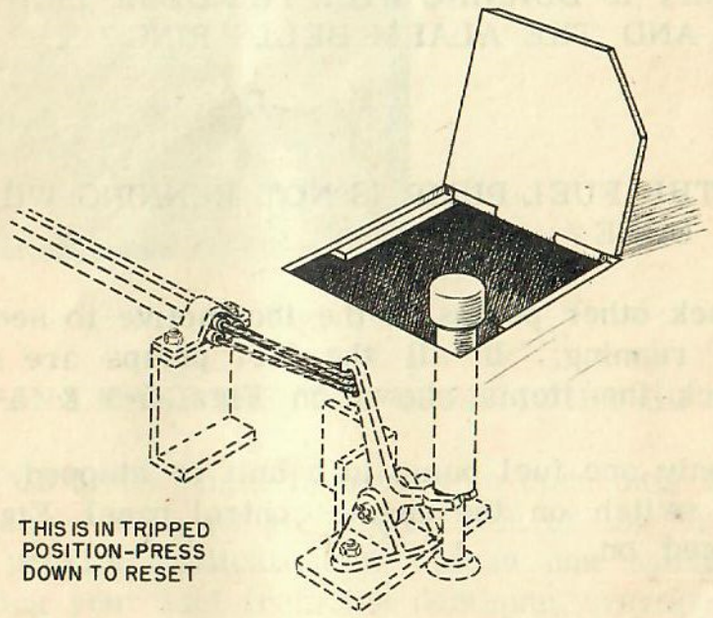


Fig. 5-8

7. IF I FIND AN ENGINE STOPPED, WHAT SHALL I DO?

Turn the isolation switch handle to "START" position (Fig. 5-4). Make certain the switches in the electrical cabinet in this unit are closed and the fuses good (Fig. 5-2), and the circuit breakers in the "ON" position (Fig. 5-7).

Then be sure the fuel pump switch is "ON" (Fig. 5-4), and check the fuel return sight glass for a good flow of fuel. (Fig. 5-3).

Look at the overspeed trip lever and move it counter-clockwise to be sure it is "set" (Fig. 5-9).

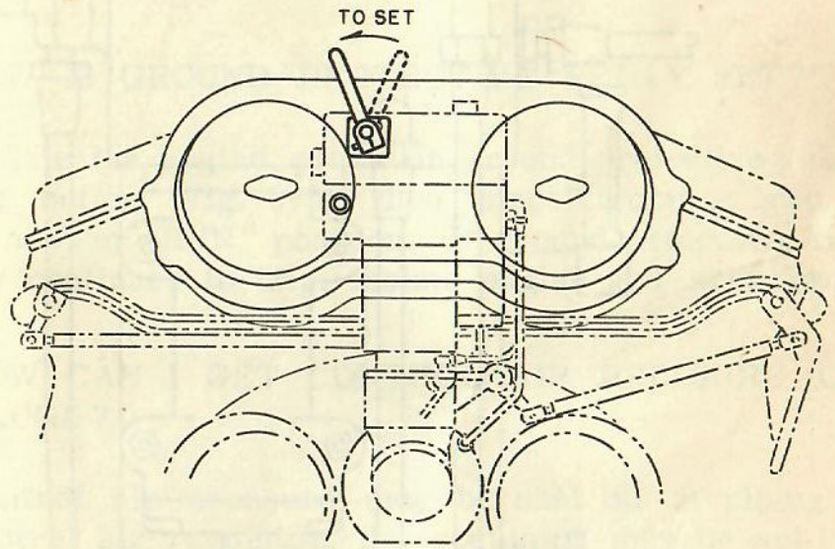


Fig. 5-9

Be sure the low oil pressure trip button on the governor is pushed in so the red part of the shaft is not showing (Fig. 5-10).

Hold the layshaft part way open and start the engine by pressing on the "START" button. Check the ground protective relay (Fig. 5-5) and the starting contactors (Fig. 5-6) and then put the isolation switch in "RUN" position.

ENGINE GOVERNOR

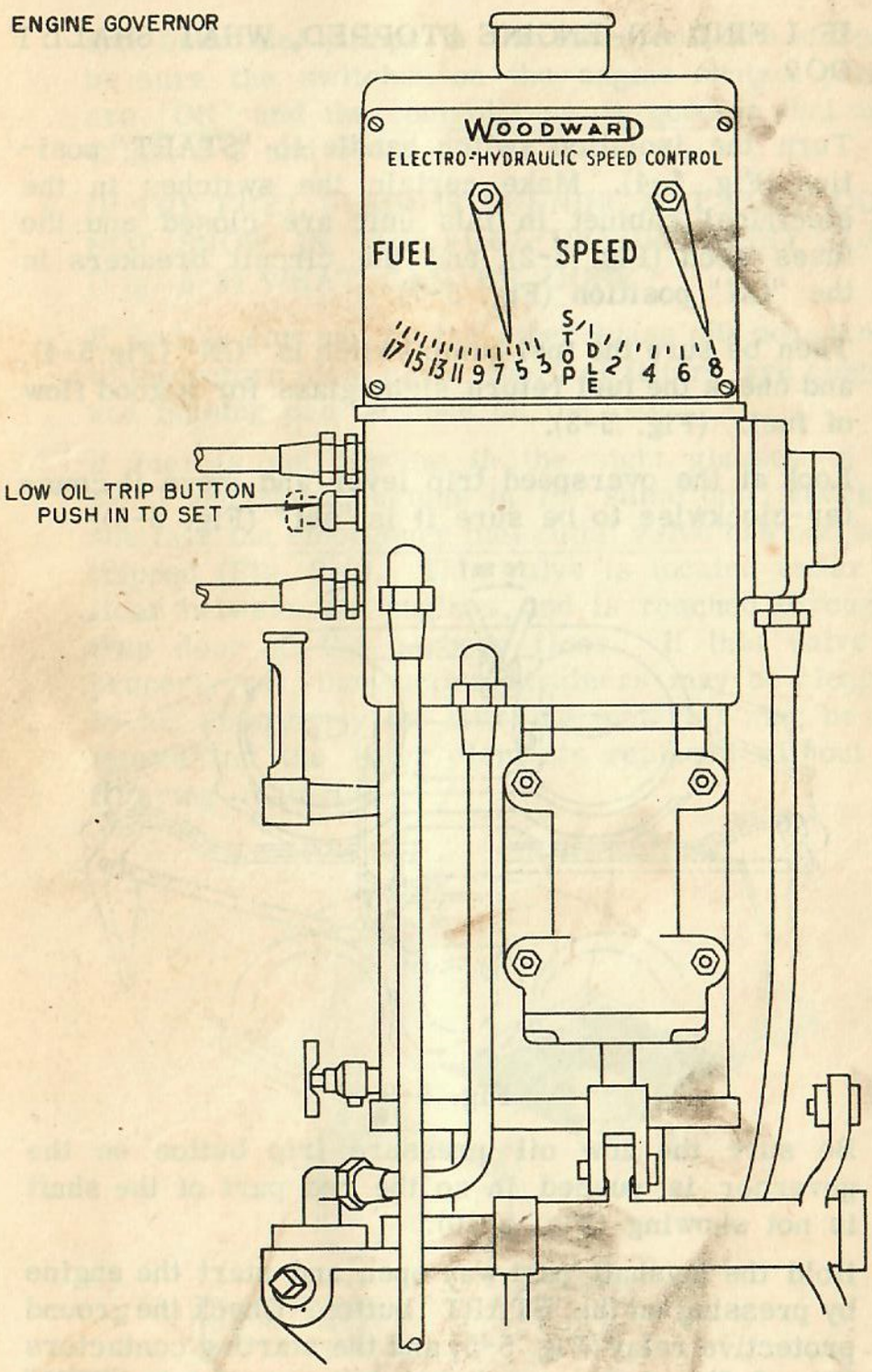


Fig. 5-10

8. HOW CAN I TELL IF AN ENGINE IS PUTTING OUT POWER?

When the engineman has the throttle in Run 8 pulling a train, the plate on the governor should appear as in Fig. 5-10. If the right hand scale does not read 8 but reads idle, the isolation switch may not be in "RUN." If the right hand scale shows 8, but the number on the left hand scale reads 8 to 10, the engine is not loaded and there is probably electrical trouble. Check the battery field fuse, it may be blown (Fig. 5-2); the control air pressure may be low or the starting contactors might be stuck (Fig. 5-6).

9. HOW IS GROUND PROTECTIVE RELAY SET?

Isolate the engine, press on ground protective relay set button (Fig. 5-5), then place isolation switch firmly in "RUN" position. If ground protective relay continues to trip, isolate engine and shut down.

10. HOW CAN I GET CONTROL AIR PRESSURE ON GAUGE?

Control air pressure may be shut off at piping to control air regulator, the regulator may be set too low (turn knob on top clockwise to raise pressure), or air may be shut off at valve in control cabinet. Control air comes from main reservoir so main reservoir pressure must be up. Pressure on gauge should be at least 70 pounds. Control air pressure as high as main reservoir is acceptable in an emergency. The correct setting is 80 pounds.

STEAM GENERATOR TROUBLE SHOOTING CHART

Symptoms	Cause of Trouble	Remedy
Panel lights do not light; bell does not ring (Control switch "OFF" Main boiler switch "ON")	Main battery switch "OPEN" Auxiliary generator switch "OPEN"	Close
	100 amp. boiler fuse (2) blown (distribution panel)	Test and replace
	15 amp. control fuse (2) blown (boiler panel)	Test and replace
Motor does not run (control switch "FILL," bell rings)	Stack switch tripped	Re-set
	Motor overload tripped	Re-set
	Coil blowdown valve "OPEN"	Close
Motor runs, no strong flow of water from water pump test valve	Water tank empty	Fill
	Valve on suction line closed (on line to treatment tank)	Open
	Drain valve on suction line or treatment tank open	Close
	Top of treatment tank not tight	Re-set and tighten
	Treatment tank strainer clogged	Clean
	Water in storage tank too hot	Make sure steam heat valve to water tank is closed

STEAM GENERATOR TROUBLE SHOOTING CHART (CONT'D)

Symptoms	Cause of Trouble	Remedy
Motor runs, no spark at electrodes	Wires from electrodes to transformer broken or grounding	Repair
	Terminals loose on transformer	Tighten
	Gap between electrodes too wide	Reduce gap (should be 3/16")
	10 amp. ignition fuse (2 on boiler panel) blown	Test and replace
Motor runs, fire does not light "Run"	Atomizing air valve closed	Open
	Motor not allowed to stop before turning switch to run	Turn "fill" briefly, then to "off." After motor has stopped and servo control is all the way down, turn to "Run."
	Electrodes not properly adjusted	Adjust. Report to maintenance.
	Nozzle not properly adjusted	Adjust. Report to maintenance.
Generator shuts off, bell rings	Stack switch tripped	Reset stack switch, refill coils, start steam generator, and set water by-pass regulator at slightly lower pressure. Report to maintenance.

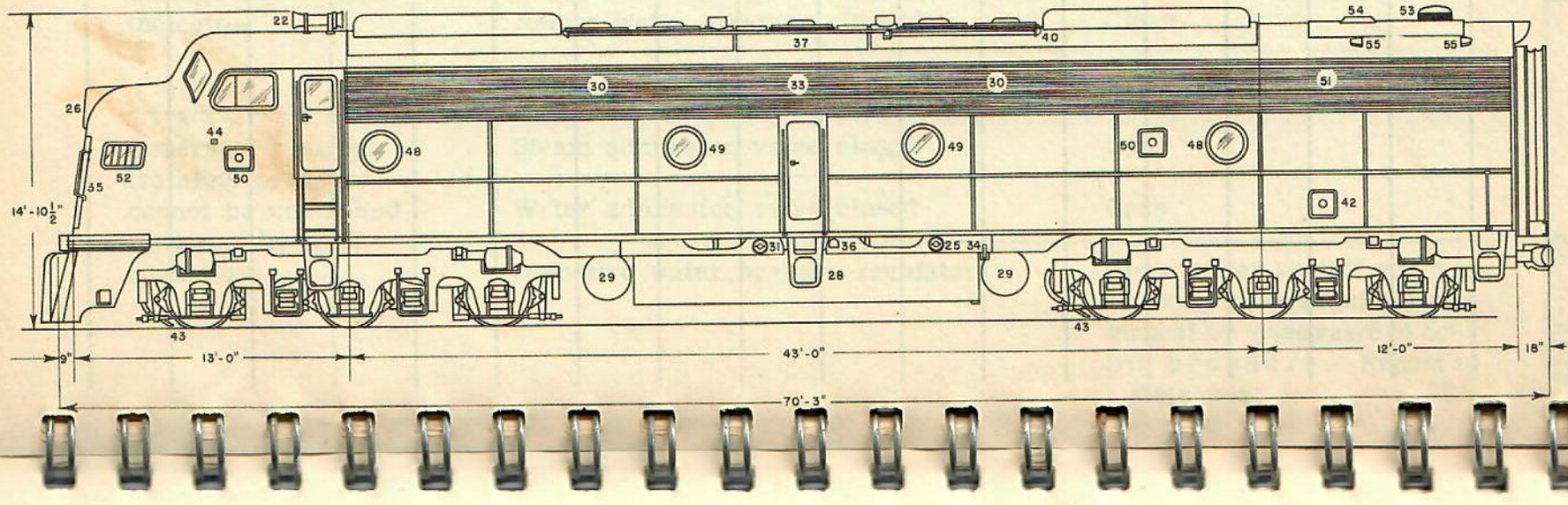
STEAM GENERATOR TROUBLE SHOOTING CHART (CONT'D)

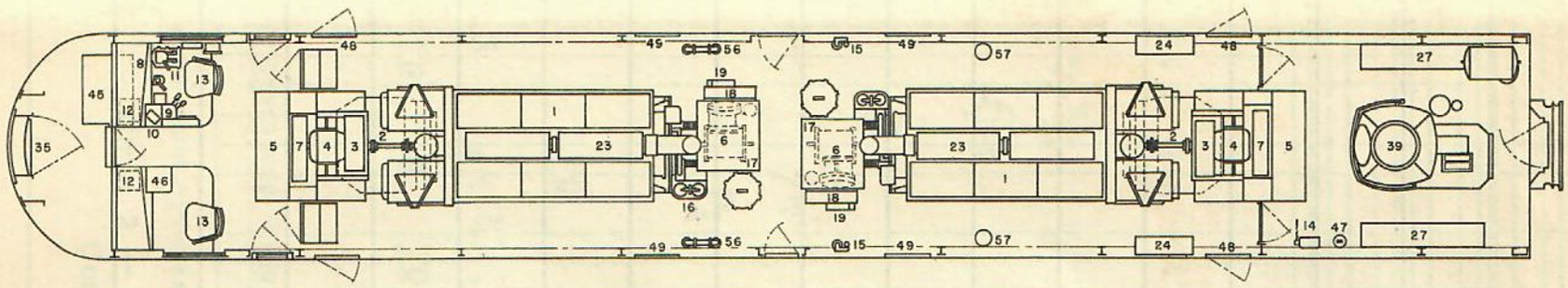
Symptoms	Cause of Trouble	Remedy
Generator shuts off, bell rings	Motor overload relay trips, shutting down generator	Reset overload relay, refill coils and start steam generator. Report to maintenance.
Generator runs, dome gets hot	Lack of air, dirty coils	Set water by-pass regulator back 10 to 15 lbs. Report to maintenance.
Generator runs but no water returns through water flow indicator	Valve in return line from separator closed	Open
	Return water strainer clogged	Clean
	Steam too dry	Report to maintenance
Generator runs but trainline pressure cannot be controlled by water by-pass regulator	Steam admission valve closed	Open
	Water admission valve closed	Open
	Defective water by-pass regulator	Close water shutoff valve to water by-pass regulator, use manual by-pass valve to control pressure. Report to maintenance.

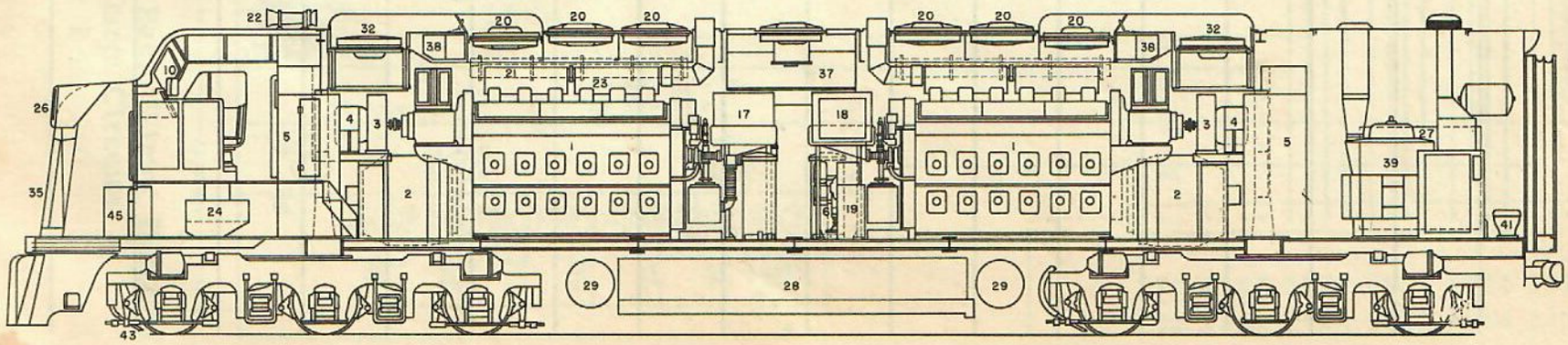
NOTES

CHART 1 - GENERAL ARRANGEMENT, DRAINS AND FILLERS

1. Engine EMD Model 12-567B
2. Main Generator & Alternator
3. Generator Blower
4. Auxiliary Generator
5. Control Cabinet
6. Air Compressor
7. Traction Motor Blower
8. Instrument Panel
9. Controller
10. Speedometer Recorder
11. Air Brake Stand
12. Cab Heater
13. Seat
14. Hand Brake
15. Fuel Tank Vent With Flame Arrestor
16. Lube Oil Filler
17. Engine Water Tank & Lube Oil Cooler
18. Engine Control & Instrument Panel
19. Load Regulator
20. 34" Fan & Motor
21. Radiator
22. Horn
23. Exhaust Manifold
24. Sand Box
25. Fuel Filler
26. Head Light
27. Batteries
28. Fuel (1200 Gal.) & Water (1350 Gal.) Tank
29. Main Air Reservoir
30. Air Intake & Shutters
31. Boiler Water Filler
32. Engine Room Ventilating Fan
33. Air Intake For Grids
34. Fuel Tank Gauge
35. Door (Plain)
36. Emergency Fuel Cut-Off
37. Dynamic Brake Hatch
38. "AC" Contactor Cabinet
39. Boiler
40. Air Compressor Aftercooler
41. Toilet
42. Battery Charging Receptacle
43. Sanding Nozzles
44. Blue Flag Bracket
45. Air Brake Rack
46. Water Cooler
47. Fire Extinguisher
48. Hinged Sash
49. Fixed Sash
50. Sand Box Filler
51. Boiler Room Shutters
52. Number Box
53. Boiler Air Intake
54. Boiler Stack
55. Battery Box Vents
56. Water Tank Vent
57. M.R. Pipeline Filter







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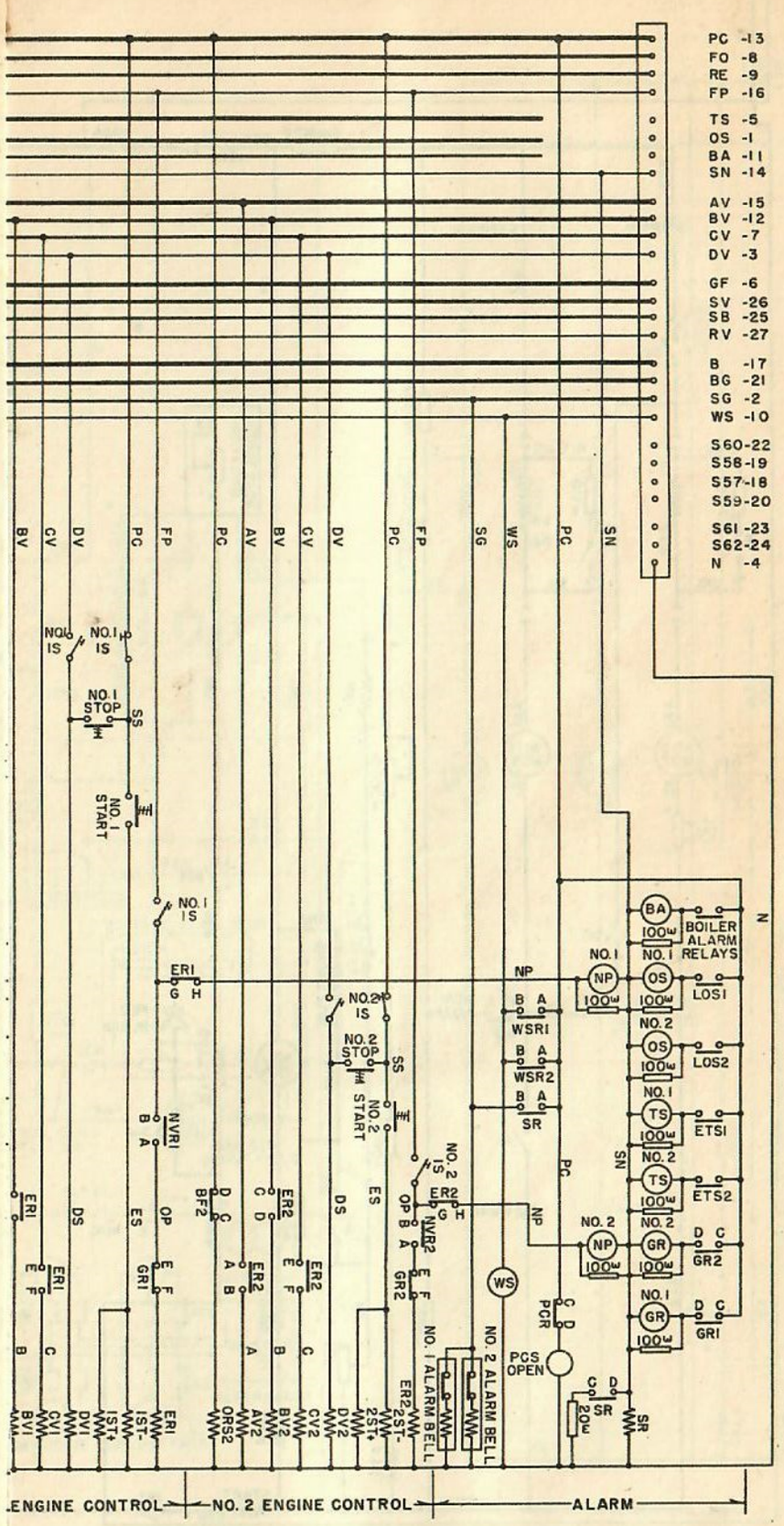


Chart 2 — Schematic Basic Wiring Diagram
Control and Alarm Circuits
Part 1

GENERATOR OR MOTOR ARMATURE

COIL - GENERATOR FIELD, MOTOR FIELD, RELAY, OR CONTACTOR

REVERSER CONTATORS AND SERIES FIELD

CONTACTOR WITH BLOW-OUT COIL

DRUM TYPE SWITCH

INTERLOCK - NORMALLY OPEN

INTERLOCK - NORMALLY CLOSED

STORAGE BATTERY

5 A. FUSE (5 AMPERES)

A AMMETER WITH SHUNT

V VOLTMETER

LIGHT RECEPTACLE

BACK UP LIGHT RECEPTACLE

BATTERY CHARGING RECEPTACLE

LIGHT

TRANSFORMER, AIR CORE

TRANSFORMER, IRON CORE

SINGLE POLE KNIFE SWITCH

DOUBLE POLE KNIFE SWITCH

SINGLE POLE SNAP SWITCH

DOUBLE POLE SNAP SWITCH

PUSH BUTTON SWITCH

PUSH-PULL SWITCH

OR FIXED RESISTOR

OR VARIABLE RESISTOR

THERMAL RELAY

TO NEGATIVE SIDE OF BATTERY

WIRE GROUNDED TO LOCOMOTIVE

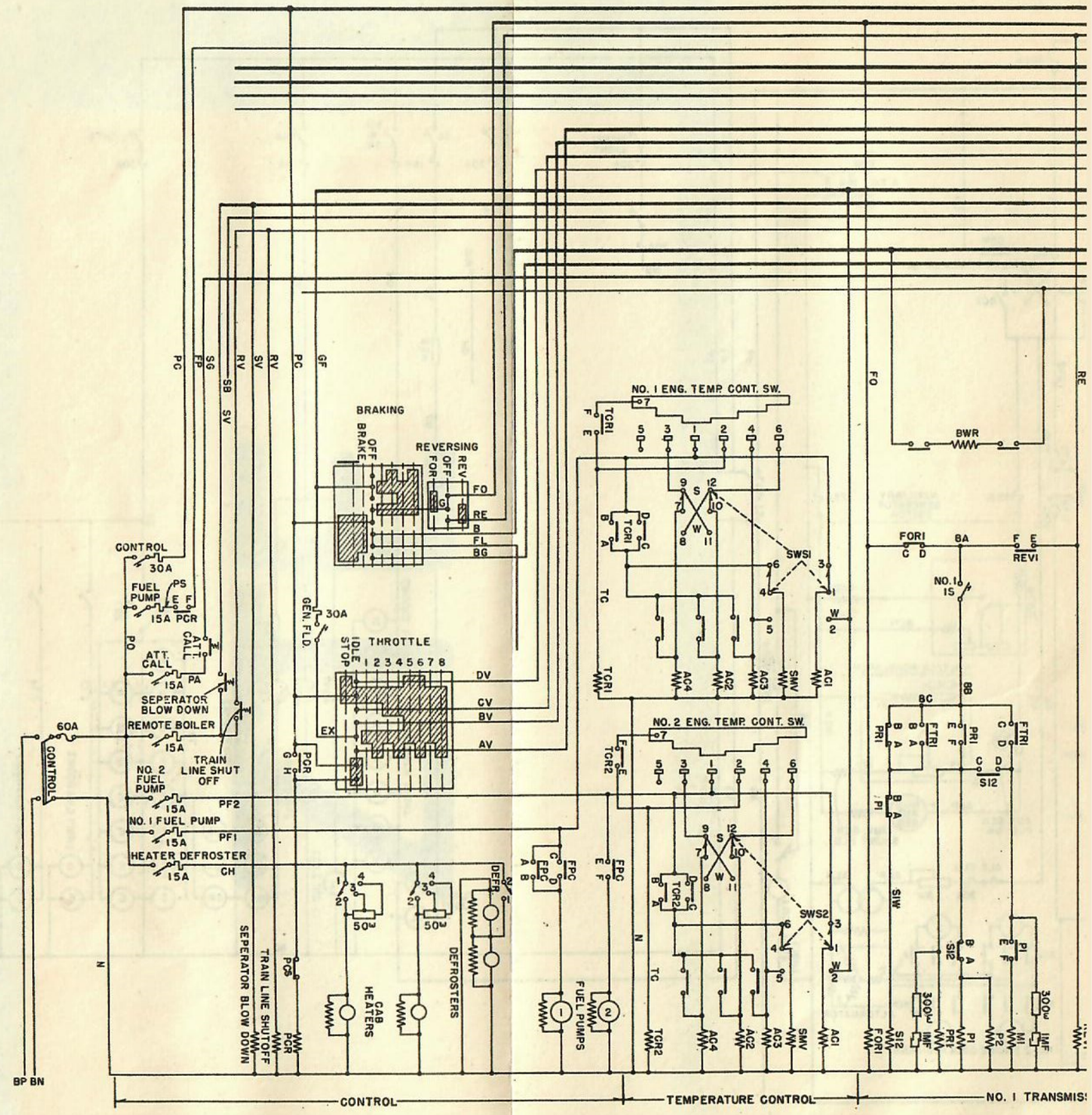
CIRCUIT CONTINUED ON ANOTHER PLATE

WIRES CONNECTED

CAPACITOR

CIRCUIT BREAKER

RHEOSTAT



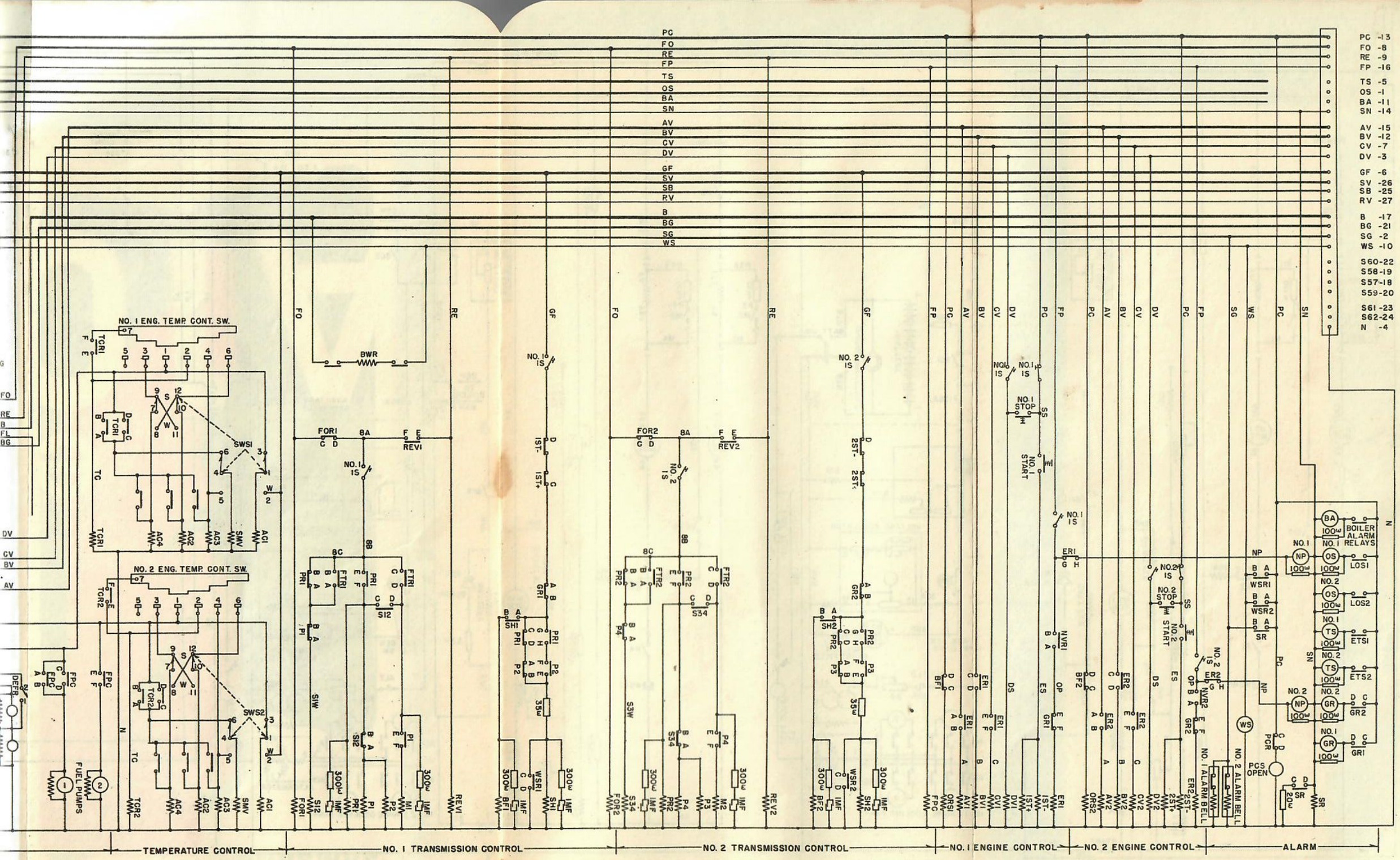


Chart 2 — Schematic Basic Wiring Diagram
Control and Alarm Circuits
Part 1

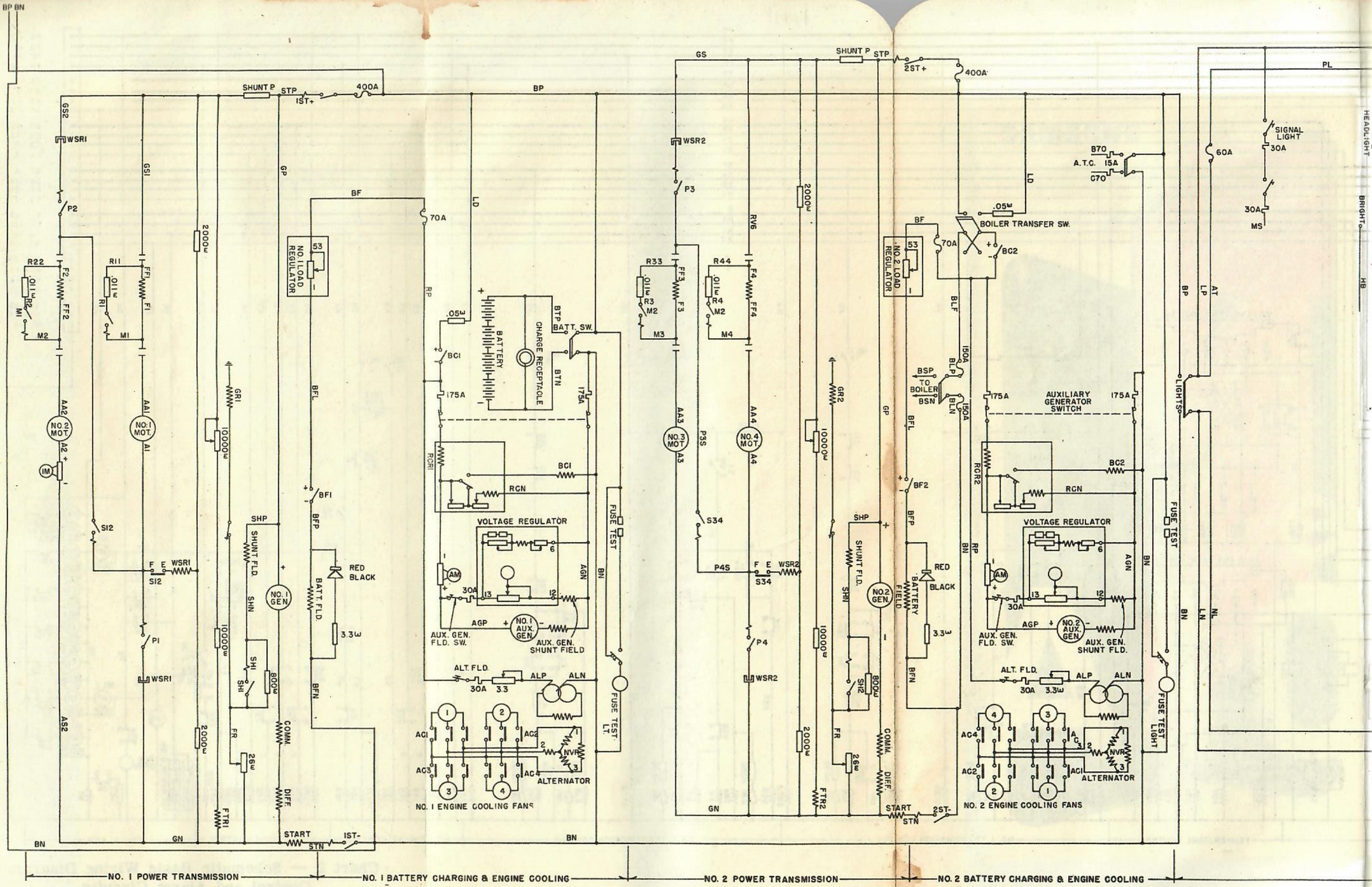
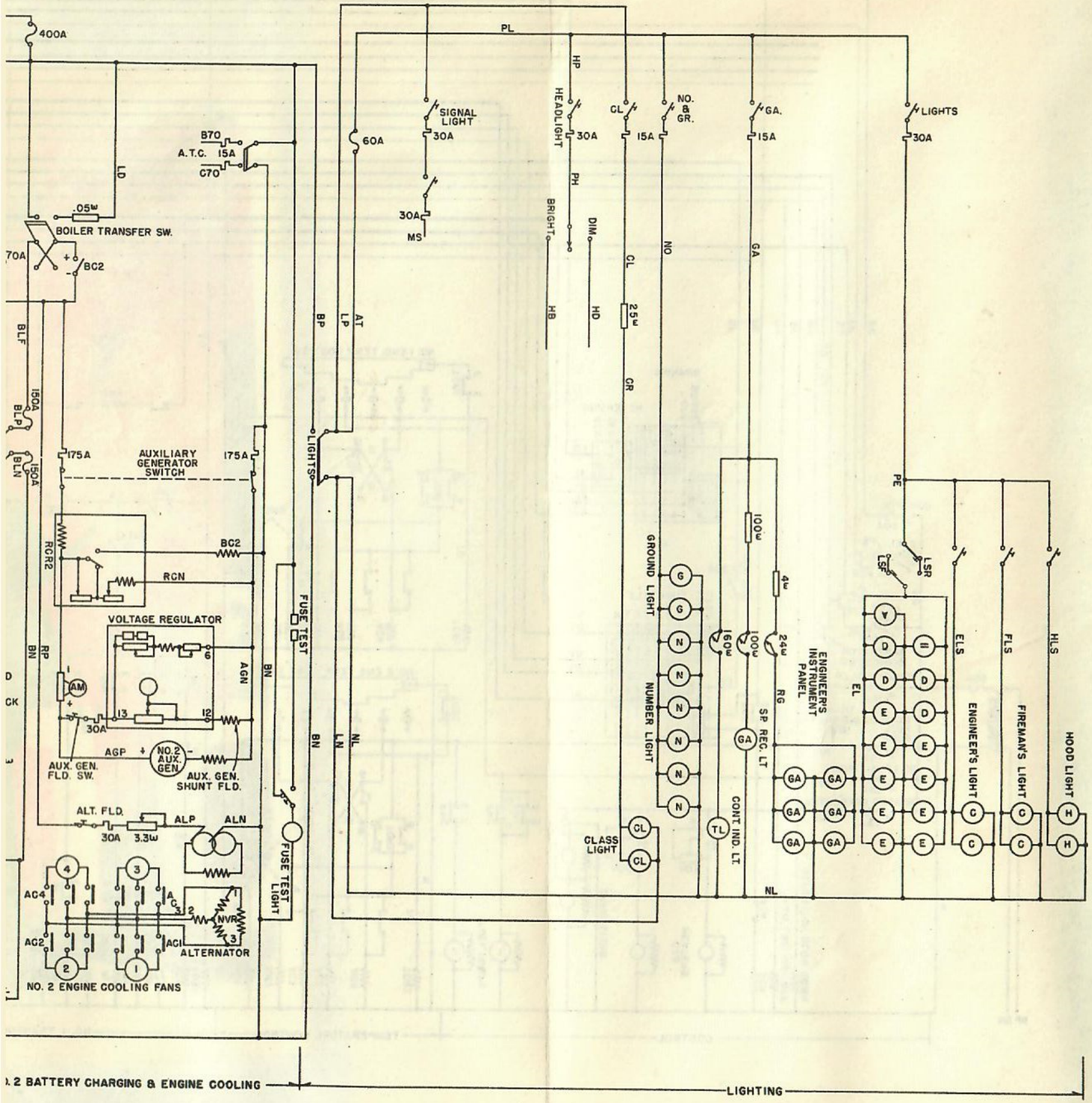


Chart 2 — Schematic Basic Wiring Diagram
High Voltage and Light Circuits
Part 2


400A
LD
.05W
BOILER TRANSFER SW.
70A
BC2
BLF
150A
BLP
BLN
150A
175A
AUXILIARY GENERATOR SWITCH
175A
RGR2
BC2
RGN
VOLTAGE REGULATOR
AM
30A
AGN
AGP
NO.2 AUX. GEN.
AUX. GEN. FLD. SW.
AUX. GEN. SHUNT FLD.
ALT. FLD.
30A
3.3W
ALP
ALN
AC4
AC3
AC2
AC1
NVR
ALTERNATOR
NO. 2 ENGINE COOLING FANS
B70
A.T.C. 15A
C70
BP
LP
AT
LIGHTS
FUSE TEST
FUSE TEST LIGHT
BN
LN
NL
60A
PL
SIGNAL LIGHT
30A
30A
MS
HP
HEADLIGHT
30A
PH
BRIGHT
DIM
HB
HD
CL
15A
25W
CR
NO.
&
GR.
15A
NO
GROUND LIGHT
NUMBER LIGHT
CLASS LIGHT
CL
GA.
15A
GA
100W
160W
100W
24W
4W
SP. REC. LT.
CONT. IND. LT.
RG
TL
ENGINEER'S INSTRUMENT PANEL
LIGHTS
30A
PE
LSF
LSR
EL
ELS
ENGINEER'S LIGHT
FLS
FIREMAN'S LIGHT
HLS
HOOD LIGHT
G
N
GA
E
D
Y
H
C
CL
TL
NL
NO. 2 BATTERY CHARGING & ENGINE COOLING
LIGHTING

SECTION 6

STEAM GENERATOR
OK – 4630, OK – 4625, OK – 4616

INTRODUCTION

The instructions contained in this section are for the guidance of personnel engaged in the operation of OK series steam generators. A general description of the steam generator is given, the operating technique is outlined and a trouble shooting section is provided for the operator.

The symbol number after each device mentioned in the text refers to the schematic operating chart, at the end of this section. The numbers are used to facilitate identification of the various devices.

The chart shows the various controls and devices on the OK series of steam generators and outlines the flow of fuel, water and steam.

DESCRIPTION

Steam generators of the 4630 series have a rated capacity of 3000 pounds of water evaporation per hour; 4625 steam generators have a rated evaporative capacity of 2500 pounds per hour; and 4616 steam generators have a capacity of 1600 pounds per hour. Operation is completely automatic after the steam generator is started, and full operating steam pressure is reached within a few minutes.

The steam generating part of the unit consists of three sets of coiled water tubing, nested and connected in series to form a single tube several hundred feet long. Water is pumped into the coil inlet and converted

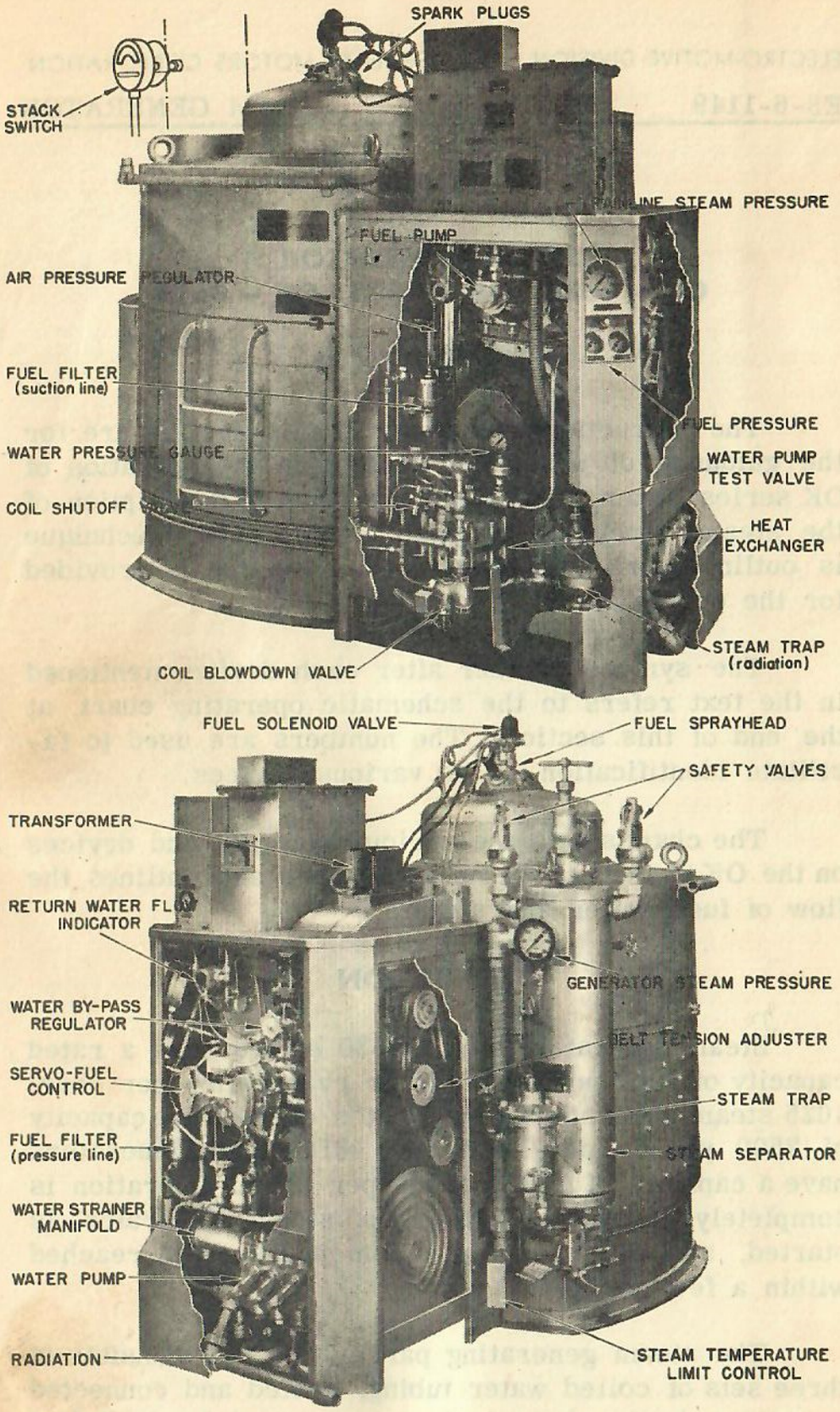


Fig. 6-1 - OK-4630 Vapor-Clarkson Steam Generator

to steam as it progresses through the coils. Heat is furnished by the combustion of diesel fuel oil, which is sprayed by compressed air through the atomizing nozzle in the fuel spray head-105 into the firepot above the coils. Here the fine oil spray mixes with air supplied by the blower-202, and is ignited by a continuous electric spark-220. The fire and hot gases flow, first downward, then outward through the nest of coils.

The supply of fuel is regulated to evaporate 90% to 95% of the water pumped through the coils. The excess water flushes scale and sludge from the coils and is carried over with the steam into the steam separator-221, where the water and sludge are removed before the steam flows into the trainline.

The excess water collects in the bottom of the steam separator. Water above the level of the return outlet flows out through a steam trap-223 and through the heat exchanger-213, where it gives up its heat to the incoming feed water. From the heat exchanger the return water flows through return water flow indicator-218 back to the water supply tank-232.

The motor converter-215 drives the blower-202, water pump-230 and fuel pump-209 at a constant speed. The water by-pass regulator-111 automatically controls steam generator output by regulating the amount of water fed to the coils. Before entering the coils, the water passes through servo-fuel control-108, which admits fuel to the spray nozzle in direct proportion to the amount of water entering the coils. The servo-fuel control also adjusts the damper-203 to admit the proper amount of air for efficient combustion of the fuel.

The trainline steam pressure is regulated by adjusting the handwheel on the water by-pass regulator-111. The length of train and the weather conditions determine the setting.

BEFORE STARTING

On OK models, the valves designated by odd numbers must be OPEN during normal operation of the steam generator. Valves designated by even numbers must be CLOSED during normal operation of the steam generator. Normally open valves are fitted with a cross type handle; normally closed valves are fitted with the standard round handle.

1. Make certain that the following valves are OPEN:

   Atomizing Air Shutoff Valve-1
   Coil Shutoff Valve-3
   Return Water Outlet Valve-9
   Steam Admission Valve-11 to Trainline Pressure Gauge-224
   Steam Admission Valve-13 to Water By-Pass Regulator-111
   Three-Way Washout Valve-17
   Water By-Pass Regulator Shutoff Valve-19
   Water Supply Stop Valve-21

2. Be sure that the following valves are CLOSED:

   Coil Blowdown Valve-2
   Layover Connection Shutoff Valve-6
   Manual Water By-Pass Valve-8
   Steam Admission Valve-10 to Radiation-217
   Washout Inlet Valves-14 and 16
   Water Pump Test Valve-18
   Water Drain Valves-20 and 22

3. See that both the overload reset button-106 and the stack switch-109 reset button are "in." The overload reset button is located inside the control panel on the magnetic overload relay.

TO FILL

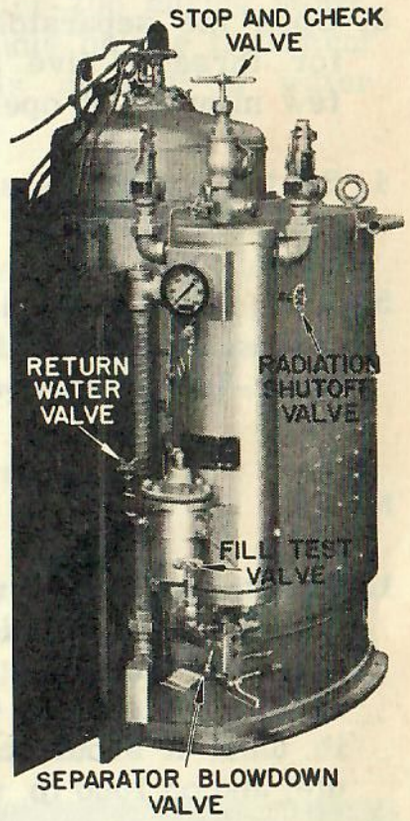
1. Open the atomizing air shutoff valve-1 and fill-test valve-4; latch open the separator blowdown valve-12 to drain the steam separator. Close the separator blowdown valve when the separator is completely drained.

2. Close the main switch and turn the control switch-102 to FILL.

3. While the coils are filling see that spark-220 is available for ignition. Check ALL valves.

4. When water discharges from the fill-test valve-4 turn the control switch-102 to OFF and close the fill-test valve.

NOTE: If the coils are empty it will take about five minutes to fill the steam generator with water.



Steam Separator on OK-4630
Fig. 6-2

TO START

CAUTION: Do not start the steam generator unless the coils are filled.

1. Latch open the separator blowdown valve-12 and turn the control switch-102 to RUN. (For easy starting, be sure the control switch has been OFF

long enough for the motor to come to a full stop).

2. Close the separator blowdown valve when the generator steam pressure gauge-212 registers 50 lbs.

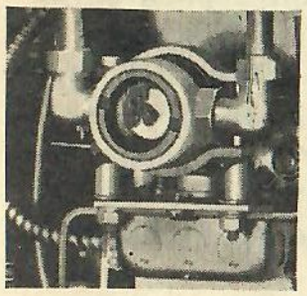
3. Open the separator blowdown valve several times for three to five second intervals during the first few minutes of operation.

4. Set the water by-pass regulator-111 to the required trainline pressure.

5. After the trainline is coupled, open the remote control trainline shutoff valve-7 by depressing the reset lever-7a. Then open the stop and check valve-15.

NOTES:

1. Check the return water flow after the steam generator has settled down to a steady output. On 3000 lb. units the return water flow indicator-218 should cycle from 4 to 12 times a minute; on 2500 lb. units it should cycle from 4 to 10 times a minute; and on 1600 lb. units from 4 to 8 times a minute.



Return Water Flow Indicator Fig. 6-3

2. If the steam generator does not start or function properly, check all valves to see that they are open or closed as indicated in the operation chart.

3. The steam generator should come up to full operating pressure in one or two minutes; it may take 10 or 15 minutes to build up the required operating steam pressure in the trainline.

RUNNING ATTENTION

1. Open the separator blowdown valve-12 for five seconds at least once every hour.

2. Turn the handle on the fuel filter-206 during stops. At the same time, turn the handle on the treatment injector filter-225, where this method of water treatment is used.

TO SHUT DOWN STEAM GENERATOR

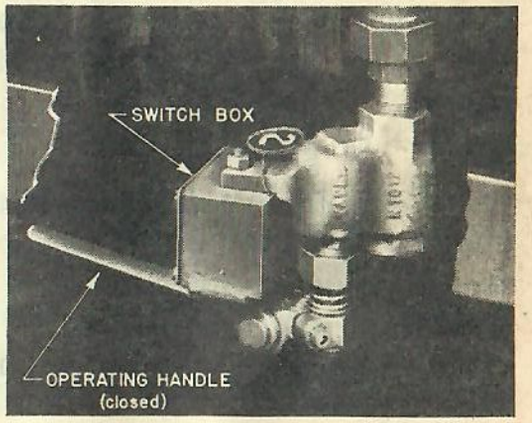
For short stops it is only necessary to close the stop and check valve-15. The fire will cycle and maintain operating pressure in the steam generator. For terminal stops, proceed as follows:

1. Close the stop and check valve-15 and the remote control trainline shutoff valve-7.

2. Set the water by-pass regulator-111 to maximum output. When the generator steam pressure gauge-212 registers 200 lbs. turn the control switch-102 to OFF.

3. Open the coil blowdown valve-2. When the generator pressure drops to 75 lbs. close the valve.

4. Open the separator blowdown valve-12 and blow down the steam separator-221 with the remaining pressure. Close the separator blowdown valve.



Coil Blowdown Valve OK-4630 Fig. 6-4

5. Fill the coils with water.

6. Close the atomizing air shutoff valve-1 and open the main switch.

NOTE: When starting, do not omit draining the steam separator, opening the fill-test valve, and again filling the steam generator with water. If the coils are already full, it will only take a moment for water to discharge from the fill-test valve.

FREEZING WEATHER PRECAUTIONS

The inlet valve-10 to the radiation-217 should be opened when operating during severe weather.

If a locomotive with a multiple installation does not have all of its steam generators in operation, open the coil blowdown valve-2, the layover connection shutoff valve-6 and the inlet valve-10 to the radiation on idle steam generators.

CAUTION: Layover connection shutoff valve-6 must be closed when trainline shutoff valve-7 is closed to cut a car out of a train.

If a locomotive is left standing out of service, operate one of the steam generators or make a connection to the yard steam line. In extremely cold weather the water pump-230 and steam generator controls should be given additional protection against freezing.

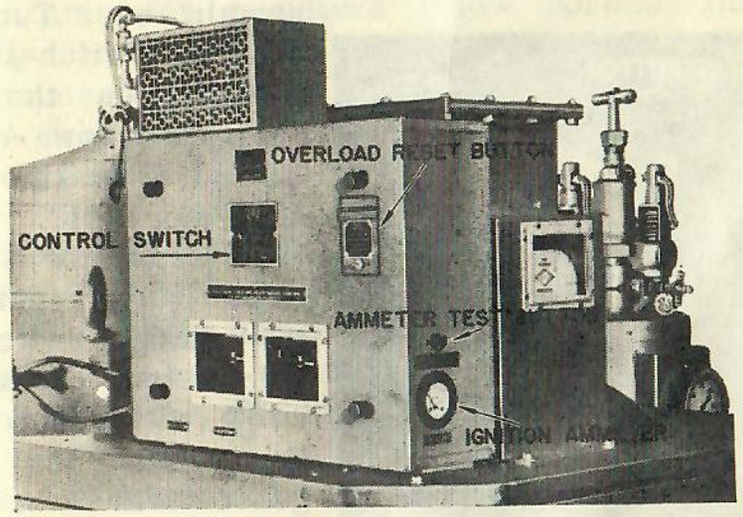
If no steam at all is available, thoroughly drain the steam generator. Open the drain valves-20 and 22,

the water pump test valve-18, the coil blowdown valve-2, the separator blowdown valve-12 and the coil shutoff valve-3. Break the pipe connections where necessary to completely drain the piping. Turn the water pump by hand to clear it of water, or blow it out with compressed air. Remove the cover of the water treatment or water strainer tank-234 and make sure it is drained.

TROUBLE SHOOTING

If one of the protective switches (magnetic overload relay, coil blowdown valve switch, stack switch high temperature contacts or low temperature contacts) operates to shut down the steam generator, the alarm will ring and the "boiler off" signal will flash on the remote control panel.

Turn the control switch-102 to OFF and use the following instructions as a guide in locating the trouble.



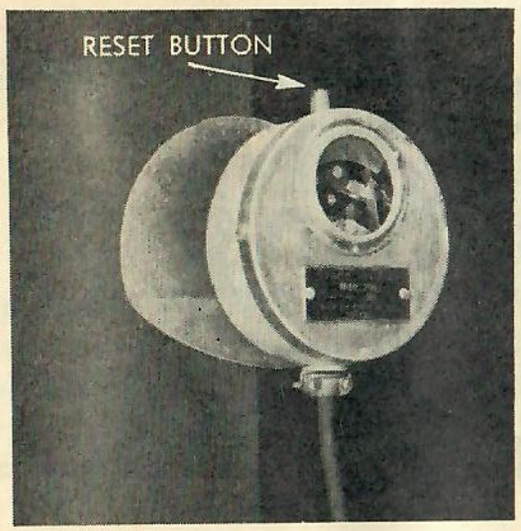
Control Panel on OK-4630
Fig. 6-5

Motor And Burner Shut Down During Operation

1. Blown fuses: The alarm will not ring and the instrument lights will go out. The main fuse (or circuit breaker) is generally located in the low voltage cabinet of the locomotive. Check this fuse, and check the control fuses in the steam generator control cabinet. A test lamp and fuse clips wired inside the control cabinet may be used to check the fuses.

2. Overload reset button-106 "out": The alarm will ring; the instrument lights will remain on. Turn the control switch-102 OFF; check for hot blower-202 or water pump-230 bearings and for poorly adjusted pulley belts. Check the setting of the belt tension adjuster. Push the overload reset button "in."

3. Stack switch-109 reset button "out": The high temperature contacts in the stack switch are open; the alarm will ring and the instrument lights will remain on. Turn the control switch-102 to OFF; open the separator blowdown valve-12 and drain the steam separator-221. Close the separator blowdown valve, push in the stack switch reset button, refill the coils with water, and then start the steam generator.



Stack Switch
Fig. 6-6

4. Coil blowdown valve-2 partially open:

The alarm will ring, the instrument lights will remain on. Be sure the locking pin on the coil blowdown valve handle is properly seated in the closed position.

Motor Starts But Burner Does Not

If the fire fails to light, the low temperature contacts on the stack switch-109 will not close, and after a 45-second time delay the outfire relay will open the circuit to shut down the steam generator. The alarm will ring and the instrument lights will remain on. Turn the control switch-102 OFF and check the following list for possible causes for the burner failure.

1. Ignition failure: Turn control switch to RUN — no spark visible through the peep hole glass, or spark is of low intensity. If an ignition fuse is blown or if the current flow is broken for any other reason, the ammeter in the ignition circuit registers zero when the ammeter test button is pressed in. If the ammeter registers below normal, the spark plug electrodes are dirty or too far apart. If the ammeter registers above normal the electrodes are too close together, or the ignition circuit is grounded.

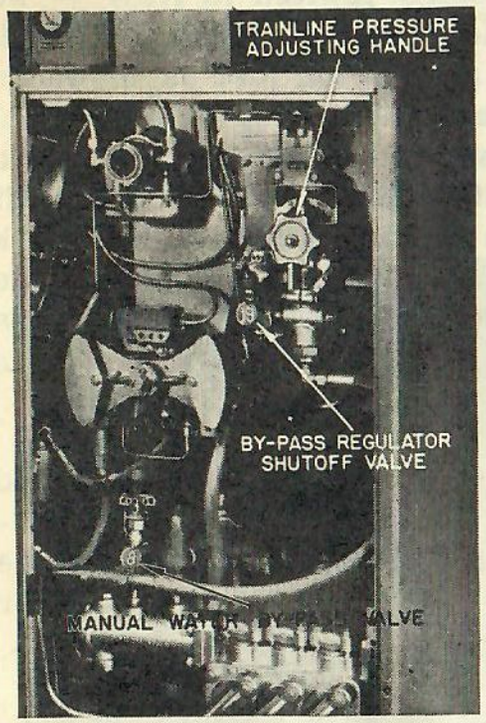
   Check the ignition fuses — use the test lamp and clips installed in the control cabinet for that purpose. Tighten loose cable connections and replace chafed or broken wire which may be breaking or grounding the circuit.

2. Low atomizing air pressure-201: The air switch-101 opens and breaks the circuit to the fuel solenoid valve-104, which then stops the flow of fuel to the sprayhead-105.

Be sure the air admission valve is fully open. Clean the strainer screen in the atomizing air line and drain the atomizing air pressure regulator-100. If the low atomizing air pressure persists, tighten the adjusting screw at the top of the air pressure regulator to increase the atomizing pressure.

3. Low fuel manifold pressure-208: Turn the handle on the suction line fuel filter-206 several times. A slight suction leak may cause the manifold pressure to build up slowly; put the control switch-102 on FILL to bleed the fuel line and bring the manifold pressure up to normal.

4. Low fuel nozzle pressure-207: Lack of water causes the servo fuel control-108 to limit the supply of fuel entering the nozzle. (If the water supply is almost completely stopped, the cam plate may come down far enough to actuate the cutout switch on the servo and close the fuel solenoid valve-104).



Feed Water Controls
OK-4630
Fig. 6-7

Be sure that the pump belts have proper tension, the water pump test valve-18 is closed, the cover on the water treatment or strainer tank-234 is tight, the three-way washout valve-17 is fully open, and that the drain valves-20 and 22 are tightly closed.

Open and close the water by-pass regulator-

111 adjusting handle several times to free the regulator from possible sediment. If the water pressure gauge-229 still registers low, close the water by-pass regulator shutoff valve-19. This closes the water by-pass line and permits all of the feed water to flow to the servo-fuel control-108; the steam generator will start at once if the by-pass regulator is causing the trouble. Set and manually regulate the trainline steam pressure by adjusting the manual water by-pass valve-8.

High feed water temperature or leaky water line connections may cause the water pump-230 to become air or vapor bound. Violent fluctuation of the water pressure gauge needle indicates this condition. Tighten leaky water line connections and bleed the line by opening the water pump test valve-18. Allow water to flow from this valve until no air or vapor bubbles are evident in the water.

Irregular Train Line Pressure

1. Burner cycles off and on: Insufficient water delivery causes the steam generator to run in superheat; the steam temperature limit control-110 operates to protect the coils against overheating. Check the water pump output as instructed in the preceding paragraphs.

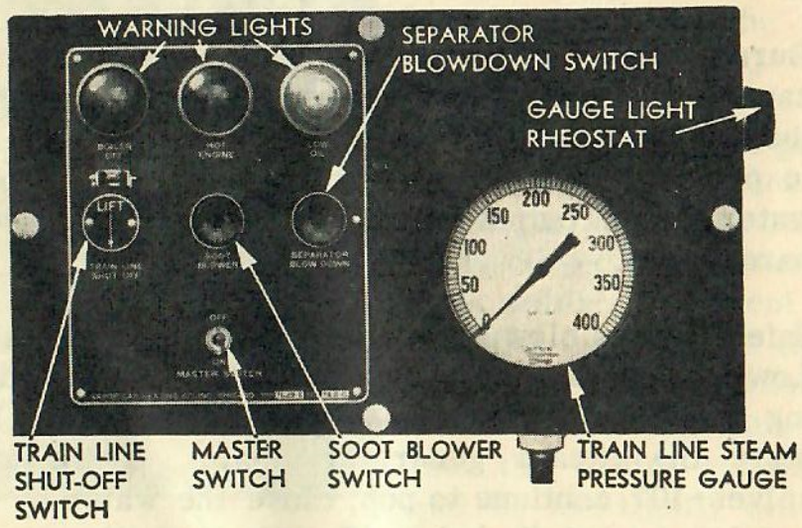
2. Safety valves blow: Shut down the steam generator. Lower the trainline pressure setting on the adjusting handle of the water by-pass regulator-111 and start the steam generator again. If the safety valves-107 continue to pop, close the water by-pass regulator shutoff valve-19 and manually regulate the trainline steam pressure by opening and adjusting the manual water by-pass valve-8.

REMOTE CONTROL EQUIPMENT

The remote control panel is located on the fireman's side of the locomotive cab. Mounted on it are a master switch to make the panel operative, and push-button switches to operate the separator blowdown valve-12 and the remote control trainline shutoff valve-7. Three warning lights are mounted on the panel and connected to the alarm circuit of the locomotive. The lights are marked "boiler off," "hot engine" and "low oil." A trainline steam pressure gauge is mounted on the panel.

A soot blower switch is also provided. It is to be used only when a steam generator of the CFK type is included in the installation.

The remote control trainline shutoff valve-7 can be closed from the cab; it must be opened manually, however. Depress the reset lever-7a on the trainline shutoff valve-7 to the position marked "open."



Remote Control Panel
Fig. 6-8

ITEMS TO REPORT

1. Water pressure greater than 450 pounds at any time.
2. Excessive stack temperature.
3. Fluctuation of the fuel manifold pressure.
4. Frequent cycling of the burner.
5. Water flow indicator not cycling.
6. Water by-pass regulator inoperative.
7. Faulty operation of the steam generator for any reason.

STEAM GENERATOR OPERATION CHART
TYPES OK-4616, OK-4625, OK-4630

100. Atomizing Air Pressure Regulator
101. Atomizing Air Switch
102. Control Switch
103. Fuel Pressure Regulator
104. Fuel Solenoid Valve
105. Fuel Spray Head
106. Overload Reset Button, Motor
107. Safety Valves
108. Servo-Fuel Control and Switch
109. Stack Switch
110. Steam Temperature Limit Control
111. Water By-Pass Regulator and Switch
112. Water Pressure Relief Valve

200. Atomizing Air Strainer
201. Atomizing Air Pressure Gauge
202. Blower
203. Damper
204. Fuel Filter (Fuel pressure line)
205. Fuel Filter (Servo actuating line)
206. Fuel Filter (Suction line)
207. Fuel Nozzle Pressure Gauge
208. Fuel Pressure Gauge (At fuel pressure regulator)
209. Fuel Pump
210. Fuel Strainer
211. Fuel Tank
212. Generator Steam Pressure Gauge
213. Heat Exchanger
214. Ignition Transformer
215. Motor Converter
216. Oil Filler Cap
217. Radiation
218. Return Water Flow Indicator
219. Return Water Strainer
220. Spark Plugs
221. Steam Separator
222. Steam Trap (Radiation)
223. Steam Trap (Return water line)
224. Trainline Steam Pressure Gauge
225. Treatment Injector Filter
226. Treatment Injector Gauge
227. Washout Solution Inlet
228. Washout Solution Outlet
229. Water Pressure Gauge
230. Water Pump
231. Water Strainer Manifold
232. Water Tank
233. Water Treatment Injector Pump
234. Water Treatment Tank (Strainer tank only if injector system is used)

VALVES

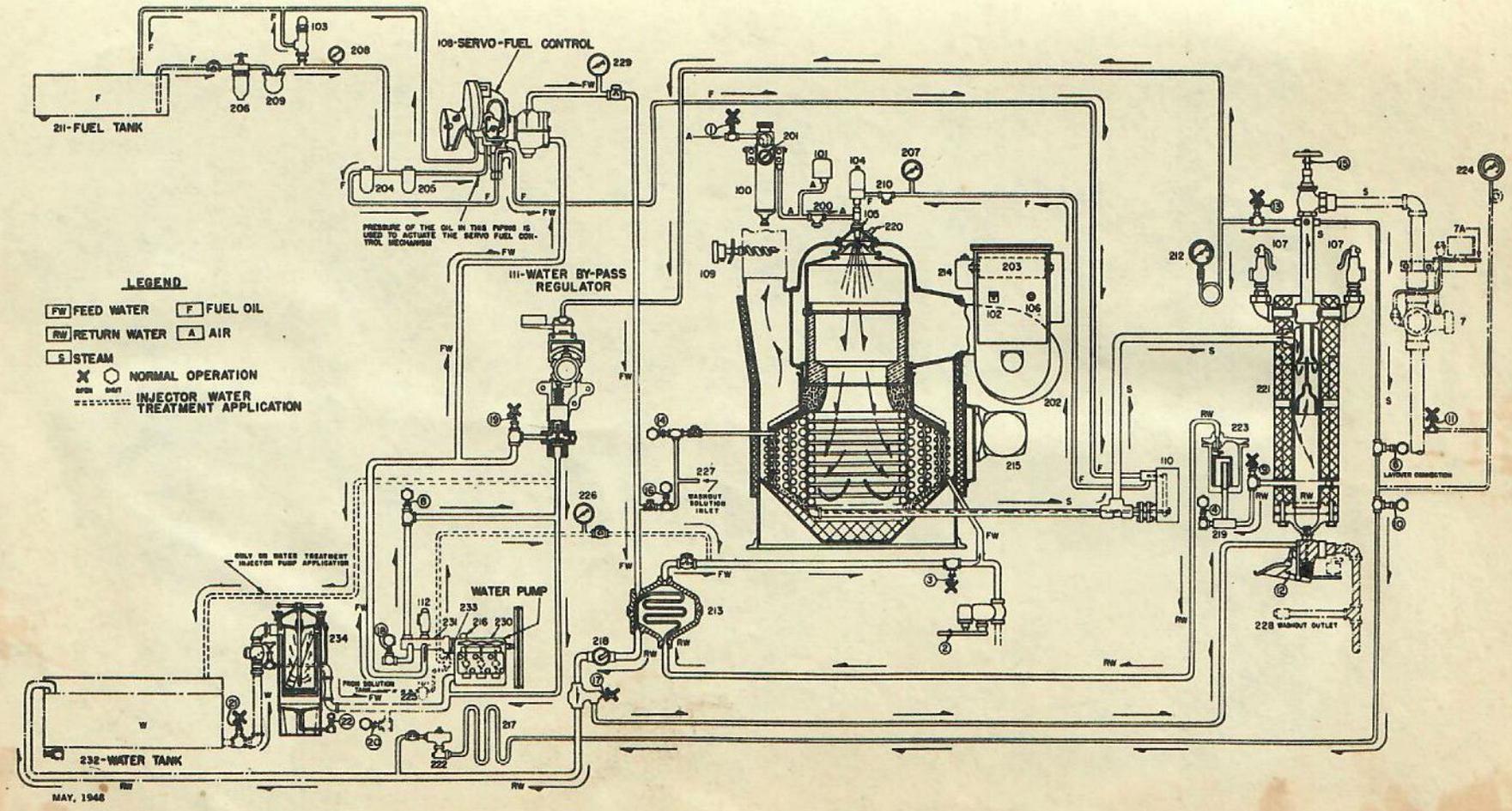
Valves designated by odd numbers must be OPEN during normal operation of the steam generator. Valves designated by even numbers must be CLOSED during normal operation of the steam generator. Normally open valves are fitted with a cross type handle, normally closed valves are fitted with the standard round handle. These designations apply only to the OK series steam generators.

The following valves must be CLOSED during normal operation of the steam generator:

2. Coil Blowdown Valve and Switch
4. Fill-Test Valve
6. Layover Connection Shutoff Valve
8. Manual Water By-Pass Valve
10. Steam Admission Valve To Radiation (Open in cold weather)
12. Steam Separator Blowdown Valve
14. Washout Inlet Valve
16. Washout Inlet Valve
18. Water Pump Test Valve
20. Water Suction Line Drain Valve
22. Water Treatment Tank Drain Valve

The following valves must be OPEN during normal operation of the steam generator:

1. Atomizing Air Shutoff Valve
3. Coil Shutoff Valve
7. Remote Control Trainline Shutoff Valve
7a. Reset Lever
9. Return Water Outlet Valve
11. Steam Admission Valve To Trainline Pressure Gauge
13. Steam Admission Valve To Water By-Pass Regulator
15. Stop and Check Valve
17. Three-Way Washout Valve
19. Water By-Pass Regulator Shutoff Valve
21. Water Supply Stop Valve.



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